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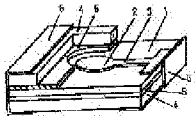
(54) PIEZOELECTRIC RESONANCE COMPONENT AND MANUFACTURE



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a stable vibration space and an excellent sealing property and to prevent the characteristic degradation of a piezoelectric resonator due to the exudation of a resin layer.

SOLUTION: In the case of manufacturing this piezoelectric resonance component constituted by holding the piezoelectric resonator 1 for which a vibration electrode 2 for vibration excitation and a pull-out electrode 3 are installed on two main surfaces by at least two sealing plates 4 for protecting the main surfaces of the piezoelectric resonator 1 and laminating them by the method, the resin layer 5 whose main component is thermosetting resin for which a glass transition temperature after setting is higher than 100°C is formed by printing so as to form the vibration space in an area near the vibration electrode on the surface in contact with the piezoelectric resonator 1 of the sealing plate 4 first. Then, the resin layer 5 is turned to a semi-set state. Thereafter, the piezoelectric resonator 1 is held by the sealing plates 4 so as to make the vibration space formation surface of the sealing plate 4 where the resin layer 5 in a semi-set state is formed and the vibration electrode 2 of the piezoelectric resonator 1 face each other. Then, the resin layer 5 in the semi-set state is truly set.

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CLAIMS

[Claim(s)]

[Claim 1] In the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator The piezo-electric resonance components characterized by forming oscillating space in said field near the

vibrating electrode by making the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more intervene between said closure plates and said piezo resonators.

[Claim 2] The piezo-electric resonance component according to claim 1 with which the thickness range of said resin layer is characterized by 10-micrometer or more being 100 micrometers or less.

[Claim 3] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which forms the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more by printing, Before the process which changes said resin layer into a semi-hardening condition, and the resin layer of said semi-hardening condition are formed, so that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate, and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 4] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode

at the principal plane of said piezo resonator The process which forms the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more by printing except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by having the process which changes said resin layer into a semi-hardening condition, the process which pinches said piezo resonator by which the resin layer of said semi-hardening condition was formed in two principal planes with said closure plate, and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 5] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which forms the 1st resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more by printing except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the vibrating electrode The process which forms the 2nd resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more by printing, The principal plane of the process which changes the said 1st and 2nd resin layer into a semi-hardening condition, and another side which does not form said 1st resin layer of said piezo resonator by printing, and the field which forms said 2nd resin layer of said 1st closure plate by printing face. And while forms said 1st resin layer of said piezo resonator by printing, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said

piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of said 1st [the] of said semi-hardening condition, and the 2nd resin layer.
[Claim 6] The manufacture approach of a piezo-electric resonance component according to claim 3, 4, or 5 that the thickness range is characterized by forming 10-micrometer or more resin layer 100 micrometers or less by printing.
[Claim 7] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more], or semi-hardening, So that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face before said resin film laminates The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate, and the process which carries out actual hardening of said resin film.
[Claim 8] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at the principal plane of said piezo resonator The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100

degrees C or more], or semi-hardening except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by equipping two principal planes with the process which pinches said piezo resonator which said resin film laminated with said closure plate, and the process which carries out actual hardening of said resin film.

[Claim 9] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which laminates the 1st resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more], or semi-hardening except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the vibrating electrode The process which laminates the 2nd resin film of un-hardening [which uses as a principal component the thermosetting resin whose glass transition temperature after hardening is 100 degrees C or more], or semi-hardening, The principal plane of another side which does not laminate said 1st resin film of said piezo resonator, and the field which laminates said 2nd resin film of said 1st closure plate face. And while laminates said 1st resin film of said piezo resonator, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of the said 1st and 2nd resin film.

[Claim 10] The manufacture approach of a piezo-electric resonance component

according to claim 7, 8, or 9 that the thickness range is characterized by laminating 10-micrometer or more resin film 100 micrometers or less.

[Claim 11] In the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator The piezo-electric resonance components characterized by making the resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s intervene between said closure plates and said piezo resonators, and forming oscillating space in said field near the vibrating electrode of said piezo resonator.

[Claim 12] The piezo-electric resonance component according to claim 11 with which the thickness range of a resin layer is characterized by 10-micrometer or more being 100 micrometers or less.

[Claim 13] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which forms the resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing, Before the process which changes said resin layer into a semi-hardening condition, and the resin layer of said semi-hardening condition are formed, so that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate,

and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 14] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at the principal plane of said piezo resonator The process which forms the resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by having the process which changes said resin layer into a semi-hardening condition, the process which pinches said piezo resonator by which the resin layer of said semi-hardening condition was formed in two principal planes with said closure plate, and the process which carries out actual hardening of the resin layer of said semi-hardening condition.

[Claim 15] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which forms the 1st resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the vibrating electrode The

process which forms the 2nd resin layer which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is 20 or more Pa-s by printing, The principal plane of the process which changes the said 1st and 2nd resin layer into a semi-hardening condition, and another side which does not form said 1st resin layer of said piezo resonator by printing, and the field which forms said 2nd resin layer of said 1st closure plate by printing face. And while forms said 1st resin layer of said piezo resonator by printing, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of said 1st [the] of said semi-hardening condition, and the 2nd resin layer, and forming the piezo-electric resonance components of a laminated structure.

[Claim 16] The manufacture approach of a piezo-electric resonance component according to claim 13, 14, or 15 that thickness of a resin layer is characterized by forming by printing in [10 micrometer or more] 100 micrometers or less.

[Claim 17] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in the field which touches said piezo resonator of said closure plate to said field near the vibrating electrode The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening, So that said oscillating space forming face of the Kii closure plate and said vibrating electrode of said piezo resonator may face before said resin film laminates The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with said closure plate,

and the process which carries out actual hardening of said resin film, and forming the piezo-electric resonance components of a laminated structure.

[Claim 18] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at the principal plane of said piezo resonator The process which laminates the resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening except for said field near the vibrating electrode, The manufacture approach of the piezo-electric resonance components characterized by equipping two principal planes with the process which pinches said piezo resonator which said resin film laminated with said closure plate, and the process which carries out actual hardening of said resin film, and forming the piezo-electric resonance components of a laminated structure.

[Claim 19] In the manufacture approach of the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which is pulled out with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from two closure plates, the 1st and the 2nd, which protect the principal plane of said piezo resonator So that oscillating space may be formed in said field near the vibrating electrode at one principal plane of said piezo resonator The process which laminates the 1st resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening except for said field near the vibrating electrode, So that oscillating space may be formed in the field which touches said piezo resonator of said 1st closure plate to said field near the

vibrating electrode The process which laminates the 2nd resin film of un-hardening [which uses as a principal component the thermosetting resin whose minimum melt viscosity at the time of heat hardening is more than 20Pa and s], or semi-hardening, The principal plane of another side which does not laminate said 1st resin film of said piezo resonator, and the field which laminates said 2nd resin film of said 1st closure plate face. And while laminates said 1st resin film of said piezo resonator, and so that a principal plane and the 2nd closure plate may face The manufacture approach of the piezo-electric resonance components characterized by having the process which pinches said piezo resonator with the said 1st and 2nd closure plate, and the process which carries out actual hardening of the said 1st and 2nd resin film, and forming the piezo-electric resonance components of a laminated structure.

[Claim 20] The manufacture approach of a piezo-electric resonance component according to claim 17, 18, or 19 that the thickness range is characterized by laminating 10-micrometer or more resin film 100 micrometers or less.

[Claim 21] The manufacture approach of the piezo-electric resonance component according to claim 13, 14, 15, 17, 18, or 19 characterized by carrying out actual hardening under pressurization 10kg/cm2 or less.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the piezo-electric resonance component which carried out the laminating of the piezo resonator with the closure plate, and its manufacture approach.

[0002]

[Description of the Prior Art] The piezo-electric resonance components known conventionally carry out the laminating of the piezo resonator which it pulls out with the electrode of a specific pattern to two principal planes of a piezo resonator, and an electrode is formed, and changes between two closure plates with which the crevice is formed in the side which faces a piezo resonator, and constitute it by forming an external electrode in **** of this layered product as indicated by JP,2-309707,A etc. The example of structure of such piezo-electric resonance components is shown in drawing 17 .

[0003] Drawing 17 is a decomposition perspective view in front of the laminating of a piezo resonator and a closure plate. The piezo resonator, the vibrating electrode with which 21 was formed in 22 and 23 were formed in the principal plane in this drawing, respectively, and the drawer electrode are installed. It is a closure plate, and the crevice is formed in the side which faces a piezo resonator 21, and 24 applies the resin layer 25 to the crevice periphery, and pastes up with a piezo resonator 21.

[0004] Drawing 18 (a) carries out the laminating of the piezo resonator 21 between two closure plates 24, and expresses the condition of having formed the external electrode. Moreover, drawing 18 (b) is a fragmentary sectional view [in / to drawing 18 (a) / an A-A side]. Thus, space is secured so that vibration by the vibrating electrode 22 on a piezo resonator 21 may not be checked by the crevice and the resin layer 25 of the closure plate 24.

[0005]

[Problem(s) to be Solved by the Invention] However, since the conventional piezo-electric resonance components have pasted up the closure plate 24 and the piezo resonator 21 in the resin layer 25, they have the fault of the adhesive property of the closure plate 24 and a piezo resonator 21 falling by the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), and reducing the sealing performance of oscillating space.

[0006] Moreover, when heat and a pressure are applied at the process which carries out actual hardening, the resin layer 25 flows in a hardening process, and there is also a fault of a resin layer oozing out, barring vibration and degrading the property of a piezo resonator in the vibrating electrode side of a piezo resonator.

[0007] This invention aims at offering the piezo-electric resonance component which the stable oscillating space and good sealing performance are acquired in consideration of the technical problem of such a conventional approach, and can prevent property degradation of the piezo resonator by the exudation of a resin layer, and its manufacture approach.

[0008]

[Means for Solving the Problem] In the piezo-electric resonance components which put and carried out the laminating of the piezo resonator which pulls out this invention with the vibrating electrode for oscillating excitation, and by which the electrode is installed in two principal planes, and constituted it from at least two closure plates for protecting the principal plane of said piezo resonator They are the piezo-electric resonance components characterized by forming oscillating space in said field near the vibrating electrode by making the resin layer which uses as a principal component the thermosetting resin whose glass transition temperature is 100 degrees C or more intervene between said closure plates and said piezo resonators.

[0009]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using drawing 5 from drawing 1 .

[0010] (Gestalt 1 of operation) The 1st gestalt about the piezo-electric resonance components of this invention is explained using drawing 1 and drawing 2 . In this drawing, the resin layer in which in a piezo resonator and 2 a drawer electrode and 4 formed the closure plate in, and, as for 5, a vibrating electrode and 3 formed [1] the oscillating space of a piezo resonator 1, and 6 are external electrodes.

[0011] Drawing 1 is claim 1 of this invention, and the notching perspective view of a piezo-electric resonance component according to claim 2. Drawing 2 (a) is the perspective view of piezo-electric resonance components, and drawing 2 (b) is a fragmentary sectional view in the A-A side of drawing 2 (a). A piezo resonator consists of piezo-electric ceramic ingredients, such as PZT, and pulls out with a vibrating electrode 2, and an electrode 3 is formed by the dry type forming-membranes methods, such as the sputtering method. If an electrical potential difference is impressed to a vibrating electrode 2 from the exterior, the oscillation mode to which it vibrates only near the vibrating electrode 2 will be excited. The resin layer 5 is installed between the piezo resonator 1 and the closure plate 4, and oscillating space is formed so that vibration of a piezo resonator 1 may not be checked. The closure plate 4 consists of ingredients, such as an alumina, and a dielectric ceramic or resin. As for the resin layer 5, glass transition temperature is using thermosetting resin, such as 100 degrees C or more, for example, epoxy etc., as the principal component. However, although thermoplastics, filler-like glass, etc. may be added as an accessory constituent if needed, the addition and class are adjusted so that the glass transition temperature as resin mixture may become 100 degrees C or more. in addition, the glass transition temperature of the thermosetting resin which constitutes the resin layer 5 -- TMA -- it asks using thermal analysis, such as law. The drawer electrode 3 is electrically connected with the external electrode 6 in the end face by two places shown by B of drawing 2 (b). The external electrode 6 is formed by the dry type forming-membranes methods, such as the wet forming-membranes methods, such as the galvanizing method, or the sputtering method. By the configuration mentioned

above, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), this invention can prevent the adhesive fall of the closure plate 4 and a piezo resonator 1, and can acquire the sealing performance of sufficient oscillating space. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of the resin layer 5 has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0012] (Gestalt 2 of operation) The 2nd gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 3 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin layers in which a drawer electrode and 4 formed the closure plate in, and 5 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 3 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 3 (b), except for the field near the vibrating electrode of a piezo resonator, resin is printed on the front face of the closure plate 4 which consists of ingredients, such as an alumina, and a dielectric ceramic or resin, by screen-stencil, and the resin layer 5 is formed in it. As for this resin, a principal component 100 degrees C or more uses [the glass transition temperature after hardening] thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Next, the closure plate 4 in which the resin layer 5 was formed is heated, and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 3 (c), a piezo resonator is laid on the closure plate in which the resin layer 5 was

formed, and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 2nd, since glass transition temperature has pasted up the closure plate and the piezo resonator with resin 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0013] (Gestalt 3 of operation) The 3rd gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 4 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin layers in which a drawer electrode and 4 formed the closure plate in, and 5 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 4 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 4 (b), except for the field near the vibrating electrode, resin is

printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. Next, except for the field near the vibrating electrode, resin is printed to the remaining principal plane of a piezo resonator by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. The resin with which the glass transition temperature after hardening uses thermosetting resin 100 degrees C or more as a principal component is used for this resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Next, the piezo resonator in which the resin layer 5 was formed is heated, and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 4 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin layer was formed, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 3rd, since glass transition temperature has pasted up the closure plate and the piezo resonator with resin 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of the resin layer 5 has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this

operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0014] (Gestalt 4 of operation) The 3rd gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 5 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin layers in which a drawer electrode and 4 formed the closure plate in, and 5 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 5 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 5 (b), except for the field near the vibrating electrode, resin is printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. Next, as shown in drawing 5 (c), except for the field near the vibrating electrode, resin is printed on one side of a closure plate by screen-stencil, and the resin layer 5 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. The resin with which the glass transition temperature after hardening uses thermosetting resin 100 degrees C or more as a principal component is used for this resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Next, the piezo resonator and the closure plate in which the resin layer was formed are heated, and are changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, it lays by turning up the field where the resin layer 5 was formed in the piezo resonator on the closure plate in which the resin layer 5 was formed as shown in drawing 5 (d), and the closure plate 4 of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next,

chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 4th, since glass transition temperature has pasted up the closure plate 4 and the piezo resonator 1 with resin 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of the resin layer 5 has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.
[0015] (Gestalt 5 of operation) The 5th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 6 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin film layers in which a drawer electrode and 4 formed the closure plate in, and 7 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 6 R> 6 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 6 (b), except for the field near the vibrating electrode of a piezo resonator, the resin film of un-hardening or semi-hardening is laminated on the front face of the closure plate 4 which consists of ingredients, such as an alumina,

and a dielectric ceramic or resin, and the resin film layer 7 is formed in it. As for this resin film, the principal component 100 degrees C or more is constituted for the glass transition temperature after hardening by thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm2 with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 6 (c), a piezo resonator is laid on the closure plate in which the resin film layer 7 was formed, and the closure plate 4 of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin film is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 5th, since glass transition temperature has pasted up the closure plate and the piezo resonator with the resin film 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0016] (Gestalt 6 of operation) The 6th gestalt about the manufacture approach

of the piezo-electric resonance components of this invention is explained using drawing 7 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin film layers in which a drawer electrode and 4 formed the closure plate in, and 7 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 7 R> 7 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 7 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and the resin film layer 7 is formed in it. Next, except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in the remaining principal plane of a piezo resonator, and a resin film layer is formed in it. As for this resin film, the principal component 100 degrees C or more is constituted for the glass transition temperature after hardening by thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm2 with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 7 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin film layer 7 was formed, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin film is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 6th, since glass transition temperature has pasted up the

closure plate and the piezo resonator with the resin film 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0017] (Gestalt 7 of operation) The 7th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 8 below. As for 1, as for a piezo resonator and 2, in this drawing, a vibrating electrode and 3 are the resin film layers in which a drawer electrode and 4 formed the closure plate in, and 7 formed the oscillating space of a piezo resonator 1. First, as shown in drawing 8 R> 8 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 8 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and a resin film layer is formed in it. Next, as shown in drawing 8 (c), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated on one side of a closure plate, and the resin film layer 7 is formed in it. As for this resin film, the principal component 100 degrees C or more is constituted for the glass transition temperature after hardening by thermosetting resin. in addition, TMA after glass transition temperature stiffened resin -- it asks by law. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm2 with the

temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, it lays by turning up the field where the resin film layer was formed in the piezo resonator on the closure plate in which the resin film layer was formed as shown in drawing 8 (d), and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. By the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 7th, since glass transition temperature has pasted up the closure plate and the piezo resonator with the resin film 100 degrees C or more, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 1 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0018] (Gestalt 8 of operation) The 8th gestalt about the piezo-electric resonance components of this invention is explained using drawing 9 and drawing 10 . In this drawing, the resin layer in which in a piezo resonator and 12 a drawer electrode and 14 formed the closure plate in, and, as for 15, a vibrating electrode and 13 formed [11] the oscillating space of a piezo resonator 11, and 16 are external electrodes. Drawing 9 is the notching perspective view of the piezo-

electric resonance components of this invention. Drawing 10 (a) is the perspective view of piezo-electric resonance components, and drawing 10 (b) is a fragmentary sectional view in the A-A side of drawing 10 (a). A piezo resonator consists of piezo-electric ceramic ingredients, such as PZT, and pulls out with a vibrating electrode 12, and an electrode 13 is formed by the dry type forming-membranes methods, such as the sputtering method. If an electrical potential difference is impressed to a vibrating electrode 12 from the exterior, the oscillation mode to which it vibrates only near the vibrating electrode 12 will be excited. The resin layer 15 is installed between the piezo resonator 11 and the closure plate 14, and oscillating space is formed so that vibration of a piezo resonator 11 may not be checked. The closure plate 14 consists of ingredients, such as an alumina, and a dielectric ceramic or resin. As for the resin layer 15, the minimum melt viscosity at the time of heat hardening is using thermosetting resin, such as 20 or more Pa-s, for example, epoxy etc., as the principal component. However, although thermoplastics, filler-like glass, etc. may be added as an accessory constituent if needed, the addition and class are adjusted so that the minimum melt viscosity at the time of the heat hardening as resin mixture may become 20Pa and more than s. In addition, it asks for the minimum melt viscosity of the thermosetting resin which constitutes the resin layer 15 using a rheometer. The drawer electrode 13 is electrically connected with the external electrode 16 in the end face by two places shown by B of drawing 10 (b). The external electrode 16 is formed by the dry type forming-membranes methods, such as the wet forming-membranes methods, such as the galvanizing method, or the sputtering method. By the configuration mentioned above, when heat and a pressure are applied at the process which carries out actual hardening, the resin layer 15 flows in a hardening process, and to the vibrating electrode side of a piezo resonator, a resin layer can ooze out, and this invention can bar vibration, can solve the technical problem that the property of a piezo resonator is degraded, and can acquire high-reliability and the stable property. Since sealing performance falls, and adhesion with an external electrode will fall when it is 100

micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 8 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0019] (Gestalt 9 of operation) The 9th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 11 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin layers in which a drawer electrode and 14 formed the closure plate in, and 15 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 11 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 12, and an electrode 13 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 11 (b), except for the field near the vibrating electrode of a piezo resonator, resin is printed on the front face of the closure plate 14 which consists of ingredients, such as an alumina, and a dielectric ceramic or resin, by screen-stencil, and the resin layer 15 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Next, the closure plate in which the resin layer was formed is heated and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 11 (c), a piezo resonator is laid on the closure plate in which the resin layer was formed, and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm2, since the resin layer oozed

out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 9th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 9 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0020] (Gestalt 10 of operation) The 10th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 12 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin layers in which a drawer electrode and 14 formed the closure plate in, and 15 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 12 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 12 (b), except for the field near the vibrating electrode, resin is

printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. Next, except for the field near the vibrating electrode, resin is printed to the remaining principal plane of a piezo resonator by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Next, the piezo resonator in which the resin layer was formed is heated and is changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, as shown in drawing 12 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin layer was formed, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm2, since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric

resonance components concerning the operation gestalt of the above 10th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 10 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0021] (Gestalt 11 of operation) The 11th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 13 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin layers in which a drawer electrode and 14 formed the closure plate in, and 15 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 13 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 13 (b), except for the field near the vibrating electrode, resin is printed to one principal plane of a piezo resonator by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. Next, as shown in drawing 13 (c), except for the field near the vibrating electrode, resin is printed on one side of a closure plate by screen-stencil, and the resin layer 15 is formed in it. Next, the solvent in resin volatilizes, and it dries until tuck nature is lost. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Next, the piezo resonator and the closure plate in which the resin layer was formed are heated, and are changed into a semi-hardening condition. Heating conditions are determined by the crosslinking density of resin. 60% or less of crosslinking density is desirable. Next, it lays by turning up the field where the resin layer was

formed in the piezo resonator on the closure plate in which the resin layer was formed as shown in drawing 13 (d), and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm2, since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 11th .
Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin layer has 10 micrometers or more desirable 100 micrometers or less.
In addition, although the gestalt 11 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.
[0022] (Gestalt 12 of operation) The 12th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 14 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin film layers in which a

drawer electrode and 14 formed the closure plate in, and 17 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 14 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 12, and an electrode 13 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 14 (b), except for the field near the vibrating electrode of a piezo resonator, the resin film of un-hardening or semi-hardening is laminated on the front face of the closure plate 14 which consists of ingredients, such as an alumina, and a dielectric ceramic or resin, and the resin film layer 17 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin film. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm2 with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 14 (c), a piezo resonator is laid on the closure plate in which the resin film layer was formed, and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm2, since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat

and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 12th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 12 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0023] (Gestalt 13 of operation) The 13th gestalt about the manufacture approach of the piezo-electric resonance components of this invention is explained using drawing 15 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin film layers in which a drawer electrode and 14 formed the closure plate in, and 17 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 15 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 12, and an electrode 13 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 15 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and the resin film layer 17 is formed in it. Next, except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in the remaining principal plane of a piezo resonator, and the resin film layer 17 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin film. In addition, it asks for the minimum melt viscosity of

thermosetting resin using a rheometer. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm2 with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, as shown in drawing 15 (c), a closure plate is laid and pinched on both sides of the piezo resonator in which the resin film layer was formed, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin film is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm2, since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 13th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 13 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0024] (Gestalt 14 of operation) The 7th gestalt about the manufacture approach

of the piezo-electric resonance components of this invention is explained using drawing 16 below. As for 11, as for a piezo resonator and 12, in this drawing, a vibrating electrode and 13 are the resin film layers in which a drawer electrode and 14 formed the closure plate in, and 17 formed the oscillating space of a piezo resonator 11. First, as shown in drawing 16 (a), it pulls out to the piezo resonator which consists of piezo-electric ceramic ingredients, such as PZT, with a vibrating electrode 2, and an electrode 3 forms chromium and nickel in it by the dry type forming-membranes methods, such as the sputtering method. Next, as shown in drawing 1616 (b), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated in one principal plane of a piezo resonator, and the resin film layer 17 is formed in it. Next, as shown in drawing 16 (c), except for the field near the vibrating electrode, the resin film of un-hardening or semi-hardening is laminated on one side of a closure plate, and the resin film layer 17 is formed in it. The resin with which the minimum melt viscosity at the time of heat hardening uses the thermosetting resin of 20 or more Pa-s as a principal component is used for this resin film. In addition, it asks for the minimum melt viscosity of thermosetting resin using a rheometer. Lamination conditions are determined by the softening temperature of resin. laminating by the pressure of 1-5kg/cm2 with the temperature of the range of softening temperature and +30-degree C softening temperature -- ** -- it is desirable. Next, it lays by turning up the field where the resin film layer was formed in the piezo resonator on the closure plate in which the resin film layer was formed as shown in drawing 16 (d), and the closure plate of another side is further laid and pinched from on the, and under 1-10kg/cm2 pressurization, 150 degrees C is heated for 1 hour, actual hardening of the resin is carried out, and it unifies. At the time of a pressure when the pressurization at the time of this hardening is higher than 10kg/cm2, since the resin layer oozed out, vibration was barred and the property of a piezo resonator was degraded in the vibrating electrode side of a piezo resonator, it is necessary to use the resin which made the lower limit of the minimum melt viscosity high. Next, chromium and nickel are formed by the dry

type forming-membranes methods, such as the sputtering method, on the edge which cut the edge with dicing equipment, was made to expose some drawer electrodes, and was exposed, further, on it, nickel and solder are deposited by the electrolysis galvanizing method, and an external electrode is formed. the resin layer 15 flow in a hardening process , when heat and a pressure be apply at the process which carry out actual hardening , a resin layer can ooze out , vibration can be bar , the technical problem that the property of a piezo resonator be degrade can solve , and high-reliability and the stable property can acquire to the vibrating electrode side of a piezo resonator by the configuration mentioned above by the manufacture approach of the piezo-electric resonance components concerning the operation gestalt of the above 14th . Since sealing performance falls, and adhesion with an external electrode will fall when it is 100 micrometers or more if thinner than 10 micrometers, the thickness of a resin film has 10 micrometers or more desirable 100 micrometers or less. In addition, although the gestalt 14 of this operation described the case where one piezo resonator was pinched with two closure plates, when pinching two or more piezo resonators, there is same effectiveness.

[0025] In addition, in order to check the effectiveness of the gestalt of operation of this invention described above, when it experimented in sealing performance about what various glass transition temperature was changed and was created, the result of Table 1 was obtained.

[0026]

[Table 1]

ガラス転移温度（℃）	50	70	90	105	125	140
密封性	NG	NG	NG	G	G	G

[0027] It turns out that the sealing performance of a case with a glass transition temperature of 100 degrees C or more is high so that clearly from Table 1.

[0028] Moreover, about what various the minimum melt viscosity was changed

and was created, when [the] it permeated and the broth multiplier was measured, the result as shown in Table 2 was obtained.

[0029]

[Table 2]

最低溶融粘土（Pa・S）	5	10	20	30	50	100
浸みだし係数　注(1)	>10	>10	<3	<2	<2	<2
判定	NG	NG	G	G	G	G

注(1) 浸みだし係数＝浸みだし幅÷樹脂層厚み

[0030] When the minimum melt viscosity is 20 or more so that clearly from Table 2, it turns out that it permeates and a result with a sufficient broth multiplier is shown. In addition, a broth multiplier permeates, is expressed with broth multiplier =(permeating broth width of face)/(resin thickness), and it permeates and it is [it permeates and] this amount defined by that condition as shows broth width of face and resin thickness to drawing 19 .

[0031]

[Effect of the Invention] Since glass transition temperature has pasted up the closure plate and the piezo resonator with resin or a resin film 100 degrees C or more as mentioned above according to this invention, also in the temperature change in a real operating environment (from -40 degrees C to 85 degrees C), the adhesive fall of the closure plate 4 and a piezo resonator 1 can be prevented, and the sealing performance of sufficient oscillating space can be acquired.

[0032] Moreover, since the minimum melt viscosity at the time of heat hardening has pasted up the closure plate and the piezo resonator with the resin or the resin film 20Pa and more than s, when heat and a pressure are applied at the process which carries out actual hardening, the resin layer 15 flows in a hardening process, to the vibrating electrode side of a piezo resonator, a resin layer can ooze out, vibration can be barred, the technical problem that the

property of a piezo resonator is degraded can be solved, and high-reliability and the stable property can be acquired.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The notching perspective view of the piezo-electric resonance components in the gestalt 1 of operation of this invention

[Drawing 2] For (a), the perspective view of the piezo-electric resonance components in the gestalt 1 of this operation and (b) are a fragmentary sectional view in the A-A side of drawing 2 (a).

[Drawing 3] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 2 of operation of this invention

[Drawing 4] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 3 of operation of this invention

[Drawing 5] The piezo-electricity in the gestalt 4 of operation of this invention is a decomposition perspective view in front of the laminating of ******.

[Drawing 6] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 5 of operation of this invention

[Drawing 7] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 6 of operation of this invention

[Drawing 8] The piezo-electricity in the gestalt 7 of operation of this invention is a decomposition perspective view in front of the laminating of ******.

[Drawing 9] The notching perspective view of the piezo-electric resonance components in the gestalt 8 of operation of this invention

[Drawing 10] For (a), the perspective view of the piezo-electric resonance components in the gestalt 8 of this operation and (b) are a fragmentary sectional view in the A-A side of drawing 10 (a).

[Drawing 11] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 9 of operation of this invention

[Drawing 12] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 10 of operation of this invention

[Drawing 13] The piezo-electricity in the gestalt 11 of operation of this invention is a decomposition perspective view in front of the laminating of ******.

[Drawing 14] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 12 of operation of this invention

[Drawing 15] The decomposition perspective view in front of the laminating of the piezo-electric resonance components in the gestalt 13 of operation of this invention

[Drawing 16] The piezo-electricity in the gestalt 14 of operation of this invention is a decomposition perspective view in front of the laminating of ******.

[Drawing 17] The decomposition perspective view in front of the laminating of the

conventional piezo-electric resonance components

[Drawing 18] (a) is the perspective view of the conventional piezo-electric resonance components, and (b) is a fragmentary sectional view in the A-A side of drawing 18 (a).

[Drawing 19] The drawing which is used when confirming the effectiveness of the minimum melt viscosity in the gestalt of operation of this invention and in which is permeated and a broth multiplier is shown

(Explanation of a sign)

1 Piezo Resonator

2 Vibrating Electrode

3 Drawer Electrode

4 Closure Plate

5 Resin Layer

6 External Electrode

11 Piezo Resonator

12 Vibrating Electrode

13 Drawer Electrode

14 Closure Plate

15 Resin Layer

16 External Electrode

17 Resin Film Layer

21 Piezo Resonator

22 Vibrating Electrode

23 Drawer Electrode

24 Closure Plate

25 Resin

26 External Electrode

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

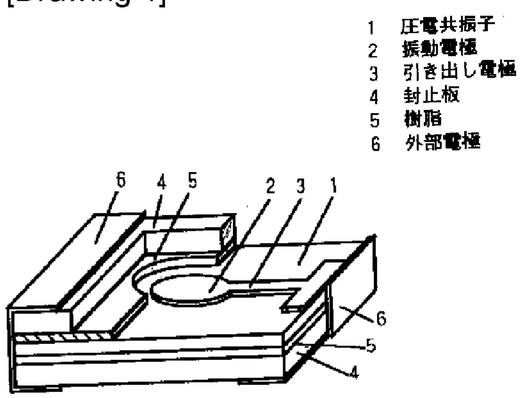
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

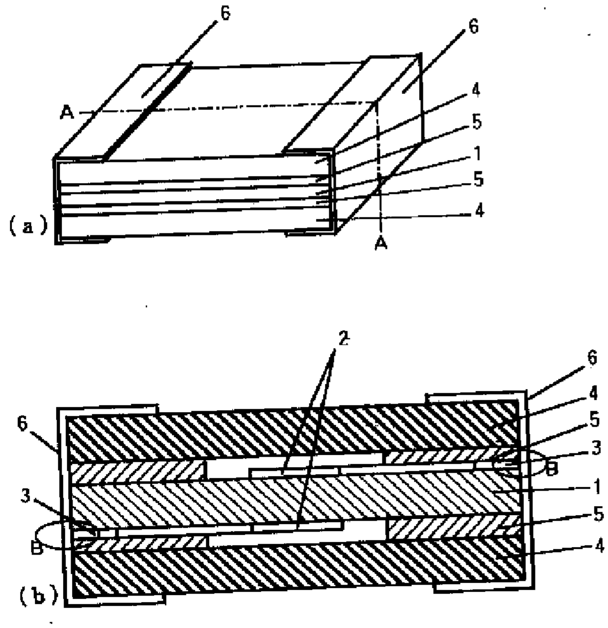
3.In the drawings, any words are not translated.

DRAWINGS

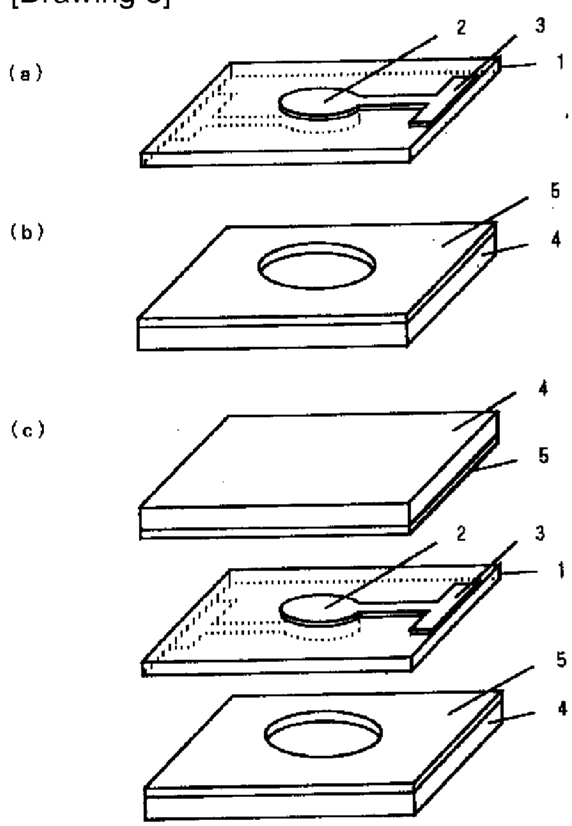
[Drawing 1]



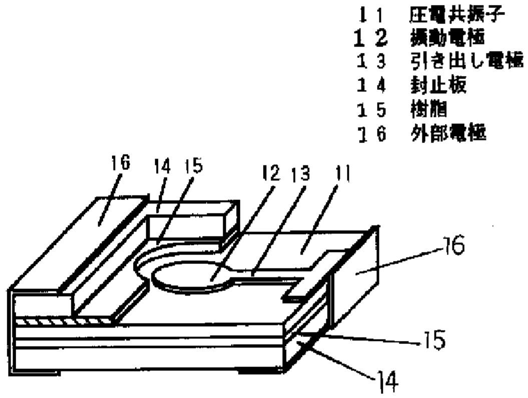
[Drawing 2]



[Drawing 3]



[Drawing 9]



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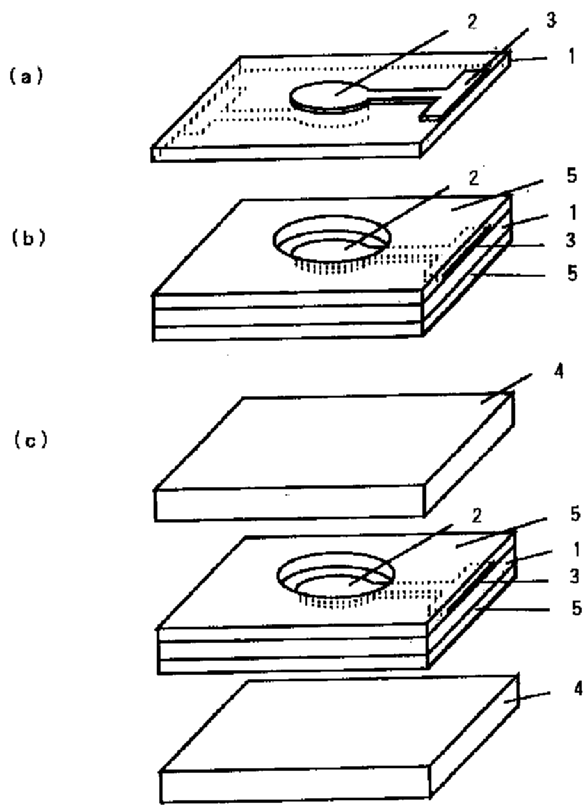

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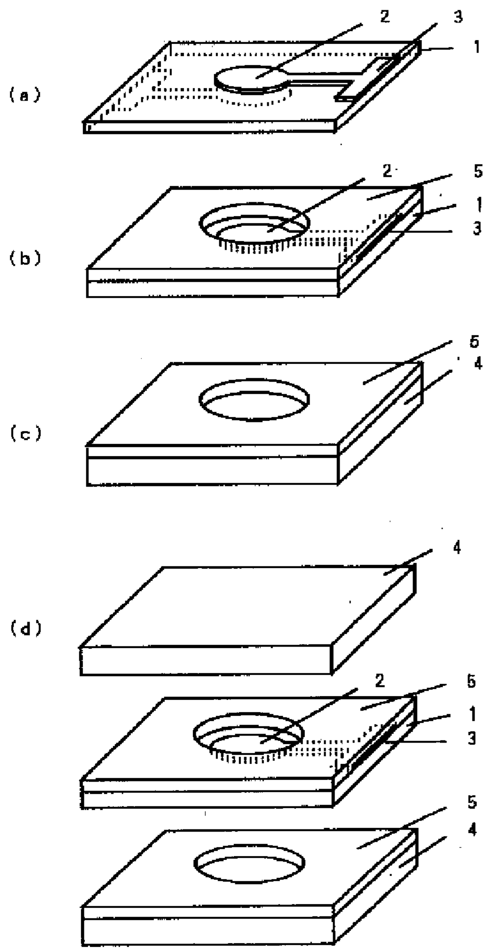
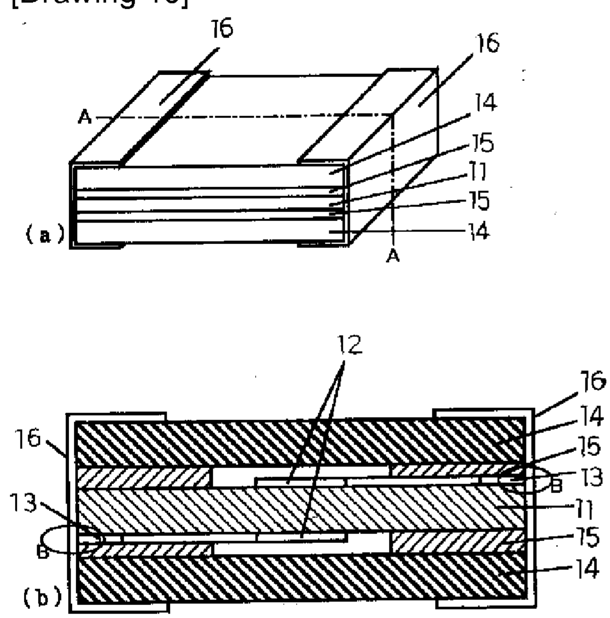
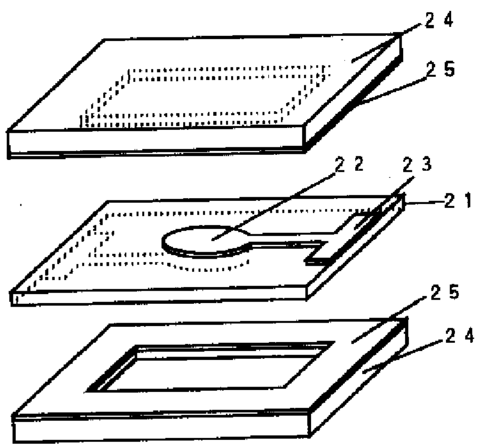

(a)
2
3
1
(b)
2
5
1
3
(c)
5
4
(d)
4
2
5
1
3
5
4

[Drawing 10]

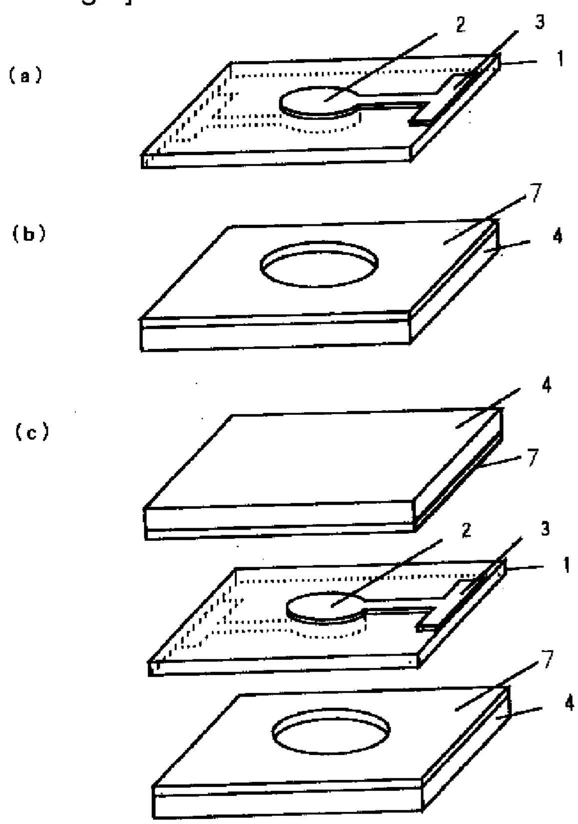

(a)
16
16
A
14
15
11
15
14
A
(b)
12
16
14
15
13
B
11
15
14
16
13
B

[Drawing 17]

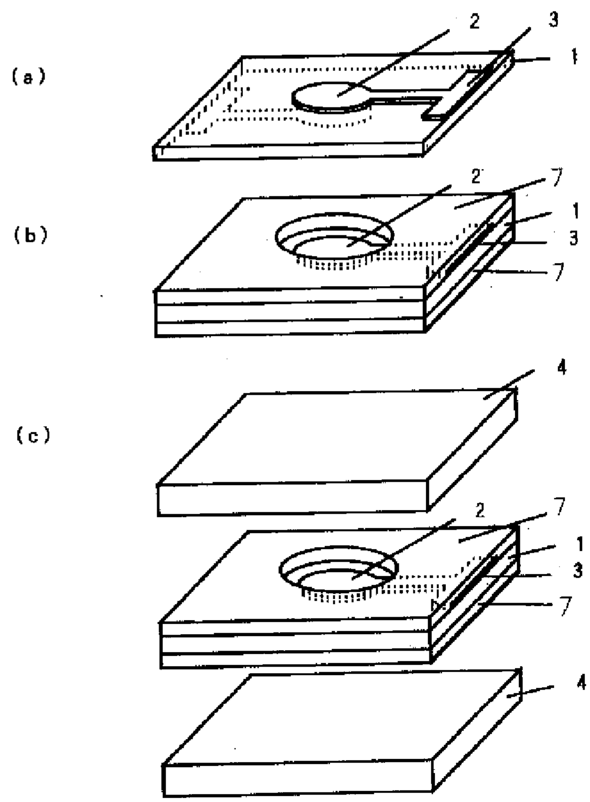
2 1 圧電共振子
2 2 振動電極
2 3 引き出し電極
2 4 封止板
2 5 樹脂



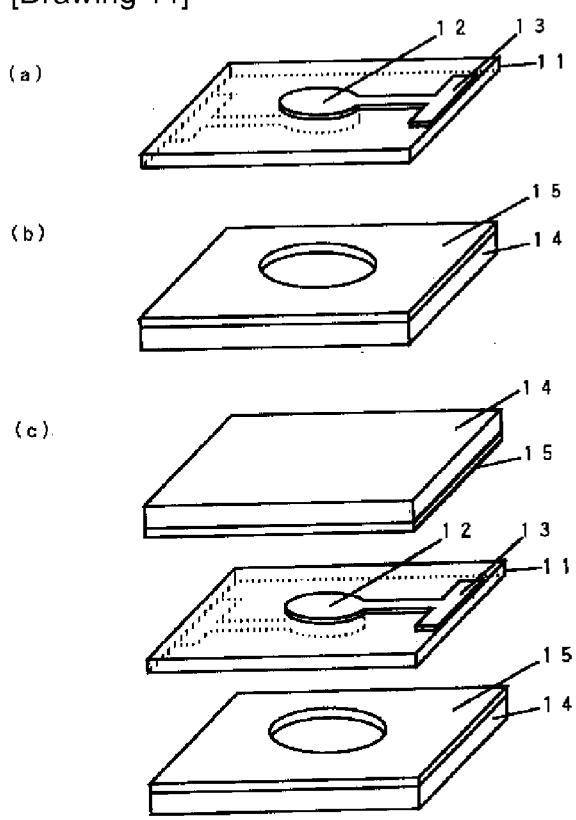
[Drawing 6]



[Drawing 7]



[Drawing 11]



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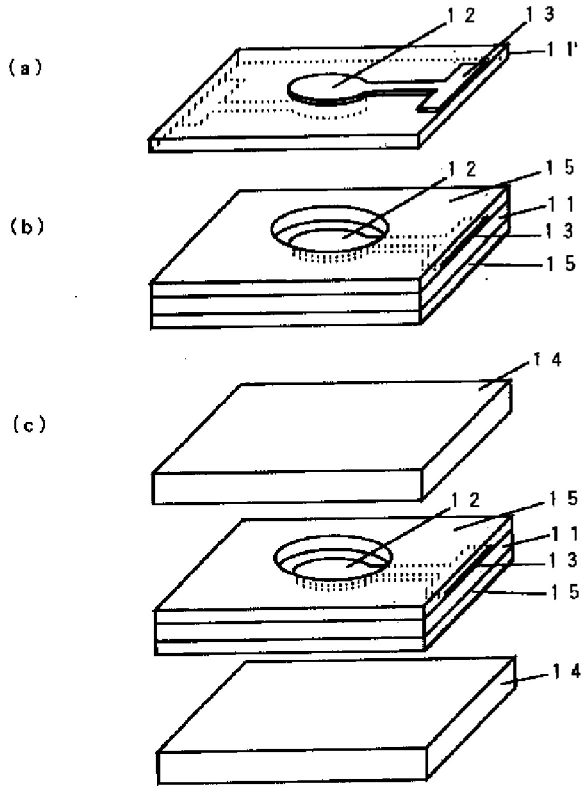

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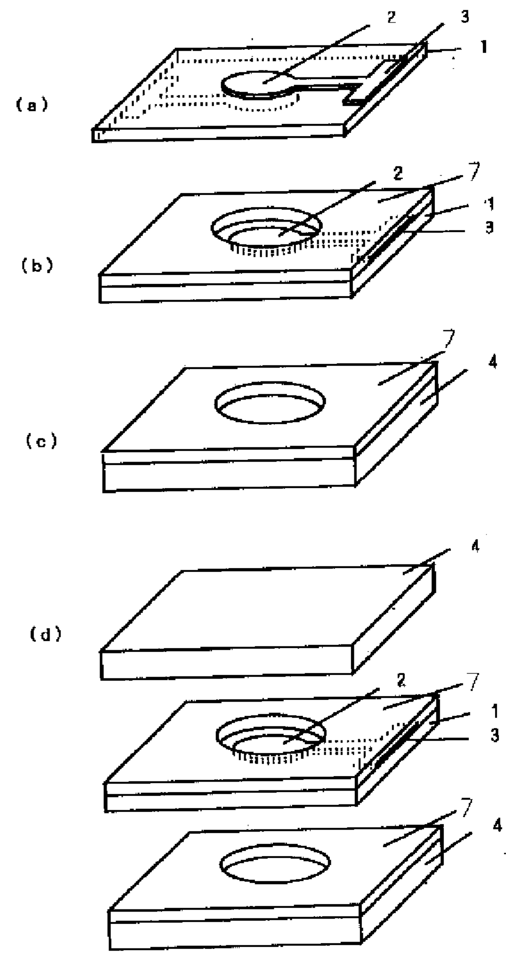
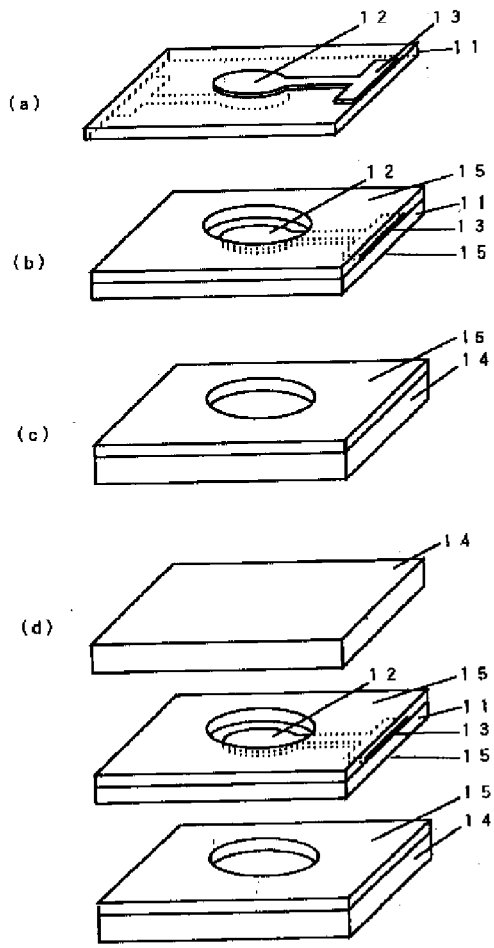
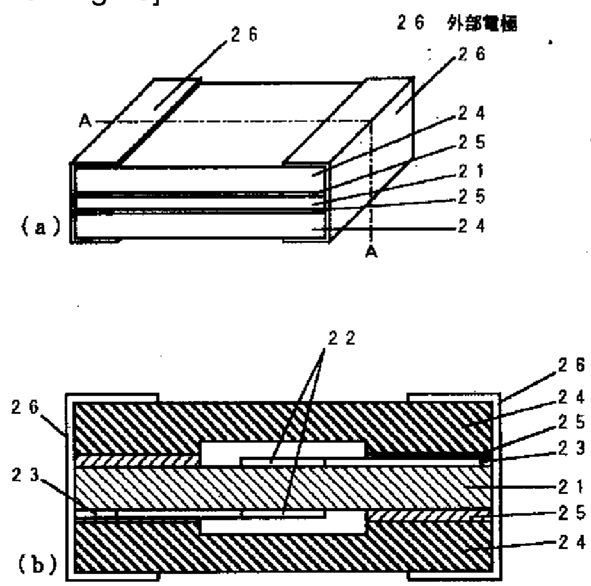


[Drawing 13]



(a)
12
13
11
(b)
12
15
11
13
15
(c)
15
14
(d)
14
12
15
11
13
15
15
14

[Drawing 18]



26 外部電極
(a)
26
26
24
25
21
25
24
A
A
(b)
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25
23
21
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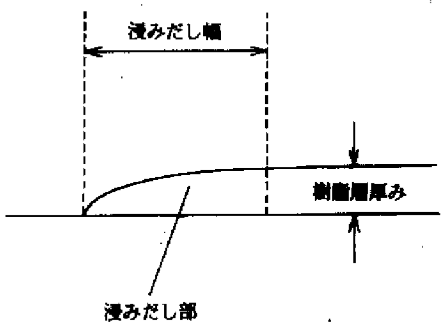
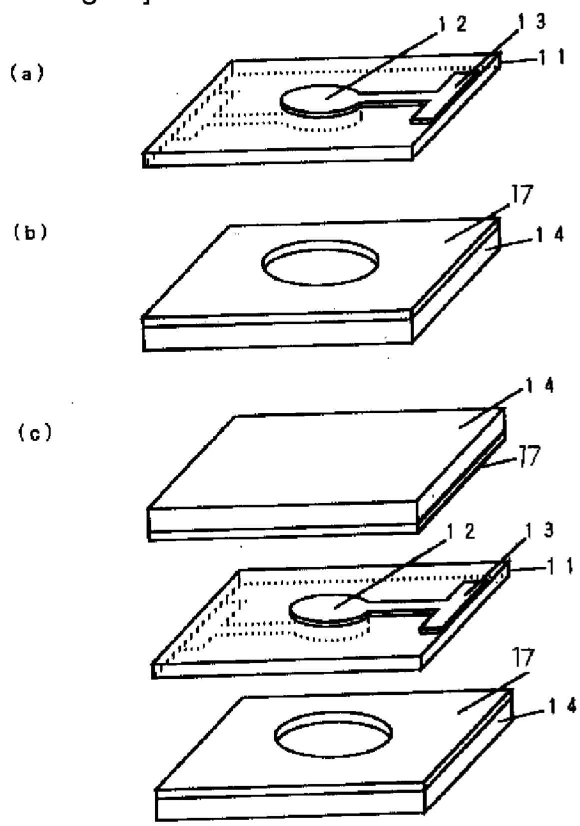
24

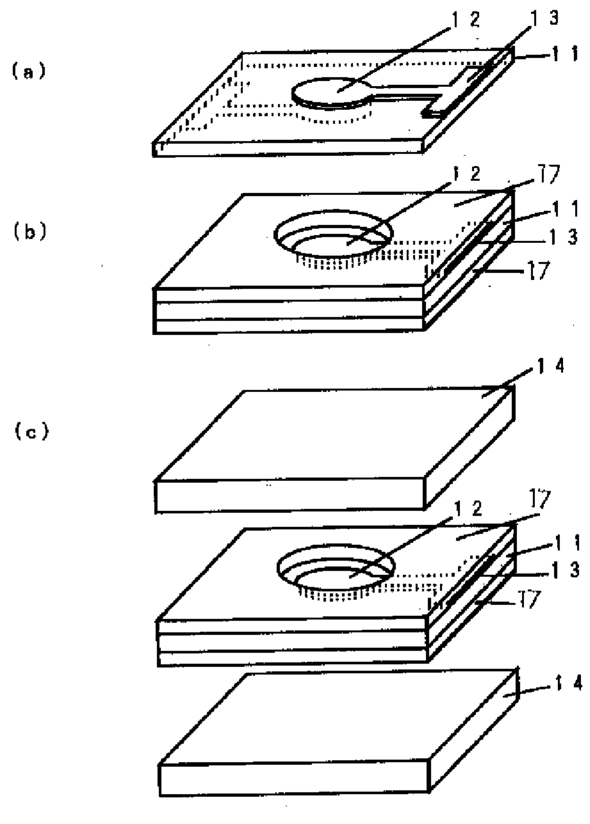
[Drawing 19]



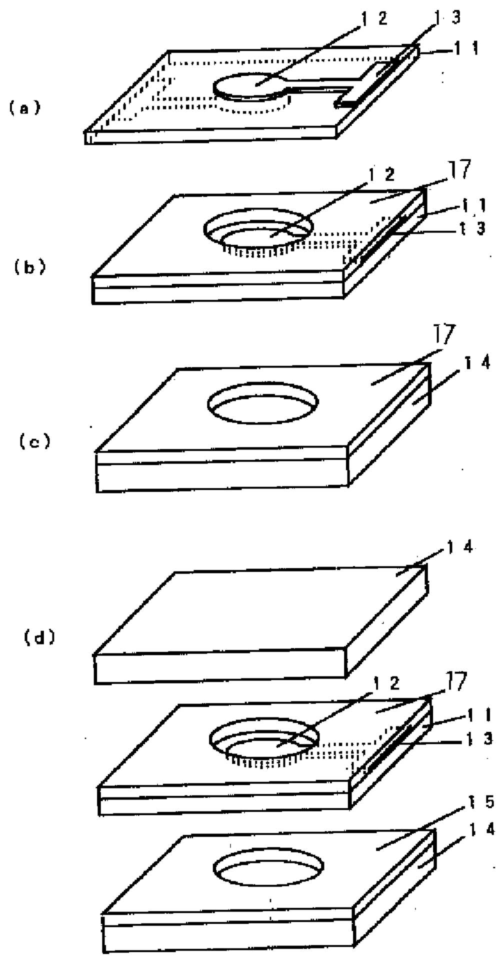
[Drawing 14]



[Drawing 15]



[Drawing 16]



[Translation done.]

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	3/02			3/02	Ｂ
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最終頁に続く

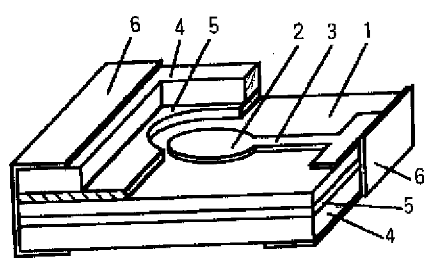
(54)【発明の名称】　圧電共振部品と製造方法

(57)【要約】

【課題】　封止板と圧電共振子を樹脂で接着しているため、使用環境内の温度変化により封止板と圧電共振子の接着性が低下する。

【解決手段】振動励振用の振動電極２と引き出し電極３が２つの主面に設置されている圧電共振子１を、圧電共振子１の主面を保護するための少なくとも２枚の封止板４で挟み込んで積層して構成した圧電共振部品の製造方法において、封止板４の圧電共振子１と接する面に、振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする樹脂層５を印刷により形成する工程と、樹脂層５を半硬化状態にする工程と、半硬化状態の樹脂層５が形成された前紀封止板４の振動空間形成面と、圧電共振子１の振動電極２とが相対するように、圧電共振子１を封止板４で挟持する工程と、半硬化状態の樹脂層５を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

1　圧電共振子
2　振動電極
3　引き出し電極
4　封止板
5　樹脂
6　外部電極



【特許請求の範囲】

【請求項１】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品において、前記封止板と前記圧電共振子の間に、ガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする樹脂層を介在させることによって、前記振動電極近傍領域に振動空間が形成されていることを特徴とする圧電共振部品。

【請求項２】　前記樹脂層の厚み範囲が、１０μm以上１００μm以下であることを特徴とする請求項１記載の圧電共振部品。

【請求項３】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、前記半硬化状態の樹脂層が形成された前紀封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが相対するように、前記圧電共振子を前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項４】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、ガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、２つの主面に前記半硬化状態の樹脂層が形成された前記圧電共振子を、前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項５】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第１、第２の２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、ガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする第１の樹脂層を印刷により形成する工程と、前記第１の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、ガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする第２の樹脂層を印刷により形成する工程と、前記第１、第２の樹脂層を半硬化状態にする工程と、前記圧電共振子の前記第１の樹脂層を印刷により形成していない他方の主面と前記第１の封止板の前記第２の樹脂層を印刷により形成している面とが相対し、かつ前記圧電共振子の前記第１の樹脂層を印刷により形成している一方の主面と第２の封止板とが相対するように、前記圧電共振子を前記第１、第２の封止板で挟持する工程と、前記半硬化状態の前記第１、第２の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項６】　厚み範囲が、１０μm以上１００μm以下の樹脂層を印刷により形成したことを特徴とする請求項３、４又は５記載の圧電共振部品の製造方法。

【請求項７】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、前記樹脂フィルムがラミネートされた前紀封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが相対するように、前記圧電共振子を前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項８】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、硬化後のガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、２つの主面に前記樹脂フィルムがラミネートされた前記圧電共振子を、前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項９】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第１、第２の２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、硬化後のガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第１の樹脂フィルムをラミネートする工程と、前記

第１の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、硬化後のガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第２の樹脂フィルムをラミネートする工程と、前記圧電共振子の前記第１の樹脂フィルムをラミネートしていない他方の主面と前記第１の封止板の前記第２の樹脂フィルムをラミネートしている面とが相対し、かつ前記圧電共振子の前記第１の樹脂フィルムをラミネートしている一方の主面と第２の封止板とが相対するように、前記圧電共振子を前記第１、第２の封止板で挟持する工程と、前記第１、第２の樹脂フィルムを本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項１０】　厚み範囲が１０μm以上１００μm以下の樹脂フィルムを、ラミネートしたことを特徴とする請求項７、８又は９記載の圧電共振部品の製造方法。

【請求項１１】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品において、前記封止板と前記圧電共振子の間に、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする樹脂層を介在させて、前記圧電共振子の前記振動電極近傍領域に振動空間が形成されていることを特徴とする圧電共振部品。

【請求項１２】　樹脂層の厚み範囲が、１０μm以上１００μm以下であることを特徴とする請求項１１記載の圧電共振部品。

【請求項１３】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、前記半硬化状態の樹脂層が形成された前紀封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが相対するように、前記圧電共振子を前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項１４】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする樹脂層を印刷により形成する工程と、前記樹脂層を半硬化状態にする工程と、２つの主面に前記半硬化状態の樹脂層が形成された前記圧電共振子を前記封止板で挟持する工程と、前記半硬化状態の樹脂層を本硬化させる工程とを備えたことを特徴とする圧電共振部品の製造方法。

【請求項１５】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第１、第２の２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする第１の樹脂層を印刷により形成する工程と、前記第１の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする第２の樹脂層を印刷により形成する工程と、前記第１、第２の樹脂層を半硬化状態にする工程と、前記圧電共振子の前記第１の樹脂層を印刷により形成していない他方の主面と前記第１の封止板の前記第２の樹脂層を印刷により形成している面とが相対し、かつ前記圧電共振子の前記第１の樹脂層を印刷により形成している一方の主面と第２の封止板とが相対するように、前記圧電共振子を前記第１、第２の封止板で挟持する工程と、前記半硬化状態の前記第１、第２の樹脂層を本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項１６】　樹脂層の厚みが、１０μm以上１００μm以下の範囲で印刷により形成したことを特徴とする請求項１３、１４又は１５記載の圧電共振部品の製造方法。

【請求項１７】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、前記樹脂フィルムがラミネートされた前紀封止板の前記振動空間形成面と、前記圧電共振子の前記振動電極とが相対するように、前記圧電共振子を前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項１８】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する少なくとも２枚の封止板で挟み

込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の樹脂フィルムをラミネートする工程と、２つの主面に前記樹脂フィルムがラミネートされた前記圧電共振子を前記封止板で挟持する工程と、前記樹脂フィルムを本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項１９】　振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護する第１、第２の２枚の封止板で挟み込んで積層して構成した圧電共振部品の製造方法において、前記圧電共振子の一方の主面に、前記振動電極近傍領域に振動空間が形成されるように、前記振動電極近傍領域を除いて、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第１の樹脂フィルムをラミネートする工程と、前記第１の封止板の前記圧電共振子と接する面に、前記振動電極近傍領域に振動空間が形成されるように、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上である熱硬化性樹脂を主成分とする未硬化もしくは半硬化の第２の樹脂フィルムをラミネートする工程と、前記圧電共振子の前記第１の樹脂フィルムをラミネートしていない他方の主面と前記第１の封止板の前記第２の樹脂フィルムをラミネートしている面とが相対し、かつ前記圧電共振子の前記第１の樹脂フィルムをラミネートしている一方の主面と第２の封止板とが相対するように、前記圧電共振子を前記第１、第２の封止板で挟持する工程と、前記第１、第２の樹脂フィルムを本硬化させる工程とを備え、積層構造の圧電共振部品を形成することを特徴とする圧電共振部品の製造方法。

【請求項２０】　厚み範囲が１０μm以上１００μm以下の樹脂フィルムを、ラミネートしたことを特徴とする請求項１７、１８又は１９記載の圧電共振部品の製造方法。

【請求項２１】　１０kg/cm^{2}以下の加圧下で本硬化することを特徴とする請求項１３、１４、１５、１７、１８又は１９記載の圧電共振部品の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、圧電共振子を封止板と共に積層した圧電共振部品とその製造方法に関するものである。

【０００２】

【従来技術】従来より知られている圧電共振部品は、特開平２－３０９７０７号公報等に開示されているように、圧電共振子の２つの主面に特定パターンの電極と引き出し電極が形成されて成る圧電共振子を、圧電共振子に面する側に凹部が形成されている２つの封止板間に積層して、この積層体の端面に外部電極を形成することによって構成している。このような圧電共振部品の構造例を図１７に示す。

【０００３】図１７は圧電共振子と封止板の積層前の分解斜視図である。同図において２１は圧電共振子、２２、２３はそれぞれその主面に形成された振動電極および引き出し電極が設置されている。２４は封止板であり、圧電共振子２１に面する側に凹部が形成されており、その凹部周辺部に樹脂層２５を塗布し圧電共振子２１と接着する。

【０００４】図１８（ａ）は圧電共振子２１を２つの封止板２４間に積層し、外部電極を形成した状態を表している。また図１８（ｂ）は図１８（ａ）にＡ－Ａ面における部分断面図である。このように封止板２４の凹部と樹脂層２５によって圧電共振子２１上の振動電極２２による振動を阻害しないように空間を確保している。

【０００５】

【発明が解決しようとする課題】しかしながら従来の圧電共振部品は、封止板２４と圧電共振子２１を樹脂層２５で接着しているため、実使用環境内の温度変化（－４０℃から８５℃）により封止板２４と圧電共振子２１の接着性が低下し、振動空間の密封性を低下させるという欠点がある。

【０００６】また、本硬化させる工程で熱や圧力がかかることにより、樹脂層２５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという欠点もある。

【０００７】本発明は、このような従来の方法の課題を考慮し、安定した振動空間と良好な密封性が得られ、かつ樹脂層のしみ出しによる圧電共振子の特性劣化を防ぐことが出来る圧電共振部品とその製造方法を提供することを目的としている。

【０００８】

【課題を解決するための手段】本発明は、振動励振用の振動電極と引き出し電極が２つの主面に設置されている圧電共振子を、前記圧電共振子の主面を保護するための少なくとも２枚の封止板で挟み込んで積層して構成した圧電共振部品において、前記封止板と前記圧電共振子の間に、ガラス転移温度が１００℃以上である熱硬化性樹脂を主成分とする樹脂層を介在させることによって、前記振動電極近傍領域に振動空間が形成されていることを特徴とする圧電共振部品である。

【０００９】

【発明の実施の形態】以下、本発明の実施の形態について図１から図５を用いて説明する。

【００１０】（実施の形態１）本発明の圧電共振部品に関する第１の形態について、図１及び図２を用いて説明する。同図において１は圧電共振子、２は振動電極、３は引き出し電極、４は封止板、５は圧電共振子１の振動

空間を形成した樹脂層、6は外部電極である。

【0011】図1は本発明の請求項1及び請求項2に記載の圧電共振部品の切り欠き斜視図である。図2（a）は圧電共振部品の斜視図であり、図2（b）は図2（a）のA－A面での部分断面図である。圧電共振子は例えばＰＺＴ等の圧電セラミック材料からなり、振動電極2と引き出し電極3はスパッタリング法などの乾式成膜法により形成する。振動電極2に外部から電圧を印加すると振動電極2の近傍のみが振動する振動モードが励振される。圧電共振子1と封止板4との間には樹脂層5が設置されており、圧電共振子1の振動を阻害しないように振動空間を形成している。封止板4は、アルミナや誘電体セラミックもしくは樹脂などの材料からなる。樹脂層5は、ガラス転移温度が１００℃以上の例えば、エポキシなどの熱硬化性樹脂を主成分としている。しかし、必要に応じて熱可塑性樹脂やフィラー状のガラスなどを副成分として添加する場合もあるが、その添加量及び種類は樹脂混合物としてのガラス転移温度が１００℃以上になるように調整したものである。尚、樹脂層5を構成する熱硬化性樹脂のガラス転移温度は、ＴＭＡ法などの熱分析法を用い求めるものである。引き出し電極3は、図2（b）のＢで示した2箇所でその端面において外部電極6と電気的に接続されている。外部電極6は、めっき法等の湿式成膜法もしくはスパッタリング法などの乾式成膜法により形成する。本発明は、上述した構成により、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層5の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0012】（実施の形態2）次に本発明の圧電共振部品の製造方法に関する第2の形態について、図3を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、5は圧電共振子1の振動空間を形成した樹脂層である。まず、図3（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図3（ｂ）に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板4の表面に、圧電共振子の振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。この樹脂は、硬化後のガラス転移温度が１００℃以上の主成分が熱硬化性樹脂を用いる。尚、ガラス転移温度は、樹脂を硬化させた後、ＴＭＡ法により求めたものである。次に、樹脂層5を形成した封止板4を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は６０％以下が望ましい。次に、図3（ｃ）に示すように、樹脂層5を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板を載置して挟持し、１～１０kg/cm²の加圧下で、１５０℃1時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第2の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が１００℃以上の樹脂により封止板と圧電共振子を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板4と圧電共振子1の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態1では、1つの圧電共振子を2つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【0013】（実施の形態3）次に本発明の圧電共振部品の製造方法に関する第3の形態について、図4を用いて説明する。同図において1は圧電共振子、2は振動電極、3は引き出し電極、4は封止板、5は圧電共振子1の振動空間を形成した樹脂層である。まず、図4（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極2と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図4（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に圧電共振子の残り主面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層5を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、硬化後のガラス転移温度が１００℃以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、ガラス転移温度は、樹脂を硬化させた後、ＴＭＡ法により求めたものである。次に、樹脂層5を形成した圧電共振子を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は６０％以下が望ましい。次に、図4（ｃ）に示すように、樹脂層を形成した圧電共振子の両面上に封止板を載置して挟持し、１～１０kg/cm²の加圧下で、１５０℃1時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電

解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第３の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が１００℃以上の樹脂により封止板と圧電共振子を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板４と圧電共振子１の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層５の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００１４】（実施の形態４）次に本発明の圧電共振部品の製造方法に関する第３の形態について、図５を用いて説明する。同図において１は圧電共振子、２は振動電極、３は引き出し電極、４は封止板、５は圧電共振子１の振動空間を形成した樹脂層である。まず、図５（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図５（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層５を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に図５（ｃ）に示すように、封止板の片面に振動電極近傍領域を除いて、スクリーン印刷により樹脂を印刷し樹脂層５を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、硬化後のガラス転移温度が１００℃以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、ガラス転移温度は、樹脂を硬化させた後、ＴＭＡ法により求めたものである。次に、樹脂層を形成した圧電共振子と封止板を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は６０％以下が望ましい。次に、図５（ｄ）に示すように、樹脂層５を形成した封止板上に圧電共振子を樹脂層５が形成された面を上にして載置しさらにその上から他方の封止板４を載置して挟持し、１～１０kg/cm^{2}の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第４の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が１００℃以上の樹脂により封止板４と圧電共振子１を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板４と圧電共振子１の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂層５の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００１５】（実施の形態５）次に本発明の圧電共振部品の製造方法に関する第５の形態について、図６を用いて説明する。同図において１は圧電共振子、２は振動電極、３は引き出し電極、４は封止板、７は圧電共振子１の振動空間を形成した樹脂フィルム層である。まず、図６（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図６（ｂ）に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板４の表面に、圧電共振子の振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層７を形成する。この樹脂フィルムは、硬化後のガラス転移温度が１００℃以上の主成分が熱硬化性樹脂により構成されている。尚、ガラス転移温度は、樹脂を硬化させた後、ＴＭＡ法により求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度＋３０℃の範囲の温度で１～5kg/cm^{2}の圧力でラミネートすることがが望ましい。次に、図６（ｃ）に示すように、樹脂フィルム層７を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板４を載置して挟持し、１～１０kg/cm^{2}の加圧下で、１５０℃１時間加熱し、樹脂フィルムを本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第５の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が１００℃以上の樹脂フィルムにより封止板と圧電共振子を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板４と圧電共振子１の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂フィルムの厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００１６】（実施の形態６）次に本発明の圧電共振部品の製造方法に関する第６の形態について、図７を用いて説明する。同図において１は圧電共振子、２は振動電極、３は引き出し電極、４は封止板、７は圧電共振子１

の振動空間を形成した樹脂フィルム層である。まず、図７（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図７（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層７を形成する。次に圧電共振子の残り主面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層を形成する。この樹脂フィルムは、硬化後のガラス転移温度が１００℃以上の主成分が熱硬化性樹脂により構成されている。尚、ガラス転移温度は、樹脂を硬化させた後、ＴＭＡ法により求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度＋３０℃の範囲の温度で１～５kg/cm²の圧力でラミネートすることがが望ましい。次に、図７（ｃ）に示すように、樹脂フィルム層７を形成した圧電共振子の両面上に封止板を載置して挟持し、１～１０kg/cm²の加圧下で、１５０℃１時間加熱し、樹脂フイルムを本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第６の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が１００℃以上の樹脂フィルムにより封止板と圧電共振子を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板４と圧電共振子１の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂フィルムの厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００１７】（実施の形態７）次に本発明の圧電共振部品の製造方法に関する第７の形態について、図８を用いて説明する。同図において１は圧電共振子、２は振動電極、３は引き出し電極、４は封止板、７は圧電共振子１の振動空間を形成した樹脂フィルム層である。まず、図８（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図８（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層を形成する。次に図８（ｃ）に示すように、封止板の片面に振動電極近傍領域を除いて、未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層７を形成する。この樹脂フィルムは、硬化後のガラス転移温度が１００℃以上の主成分が熱硬化性樹脂により構成されている。尚、ガラス転移温度は、樹脂を硬化させた後、ＴＭＡ法により求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度＋３０℃の範囲の温度で１～５kg/cm²の圧力でラミネートすることがが望ましい。次に、図８（ｄ）に示すように、樹脂フィルム層を形成した封止板上に圧電共振子を樹脂フィルム層が形成された面を上にして載置しさらにその上から他方の封止板を載置して挟持し、１～１０kg/cm²の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第７の実施形態にかかる圧電共振部品の製造方法では、ガラス転移温度が１００℃以上の樹脂フィルムにより封止板と圧電共振子を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板４と圧電共振子１の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。樹脂フィルムの厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００１８】（実施の形態８）本発明の圧電共振部品に関する第８の形態について、図９及び図１０を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１５は圧電共振子１１の振動空間を形成した樹脂層、１６は外部電極である。図９は本発明の圧電共振部品の切り欠き斜視図である。図１０（ａ）は圧電共振部品の斜視図であり、図１０（ｂ）は図１０（ａ）のＡ－Ａ面での部分断面図である。圧電共振子は例えばＰＺＴ等の圧電セラミック材料からなり、振動電極１２と引き出し電極１３はスパッタリング法などの乾式成膜法により形成する。振動電極１２に外部から電圧を印加すると振動電極１２の近傍のみが振動する振動モードが励振される。圧電共振子１１と封止板１４との間には樹脂層１５が設置されており、圧電共振子１１の振動を阻害しないように振動空間を形成している。封止板１４は、アルミナや誘電体セラミックもしくは樹脂などの材料からなる。樹脂層１５は、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の例えば、エポキシなどの熱硬化性樹脂を主成分としている。しかし、必要に応じて熱可塑性樹脂やフィラー状のガラスなどを副成分として添加する場合もあるが、その

添加量及び種類は樹脂混合物としての加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上になるように調整したものである。尚、樹脂層１５を構成する熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めるものである。引き出し電極１３は、図１０（ｂ）のBで示した2箇所でその端面において外部電極１６と電気的に接続されている。外部電極１６は、めっき法等の湿式成膜法もしくはスパッタリング法などの乾式成膜法により形成する。本発明は、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態８では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００１９】（実施の形態９）次に本発明の圧電共振部品の製造方法に関する第９の形態について、図１１を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１５は圧電共振子１１の振動空間を形成した樹脂層である。まず、図１１（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極１２と引き出し電極１３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図１１（ｂ）に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板１４の表面に、圧電共振子の振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層１５を形成する。この樹脂は、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。次に、樹脂層を形成した封止板を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は６０％以下が望ましい。次に、図１１（ｃ）に示すように、樹脂層を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板を載置して挟持し、１～１０kg/cm^{2}の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、１０kg/cm^{2}より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第９の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態９では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００２０】（実施の形態１０）次に本発明の圧電共振部品の製造方法に関する第１０の形態について、図１２を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１５は圧電共振子１１の振動空間を形成した樹脂層である。まず、図１２（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図１２（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層１５を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に圧電共振子の残り主面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層１５を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。次に、樹脂層を形成した圧電共振子を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は６０％以下が望ましい。次に、図１２（ｃ）に示すように、樹脂層を形成した圧電共振子の両面上に封止板を載置して挟持し、１～１０kg/cm^{2}の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、１０kg/cm^{2}より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第１０の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振

子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１０では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００２１】（実施の形態１１）次に本発明の圧電共振部品の製造方法に関する第１１の形態について、図１３を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１５は圧電共振子１１の振動空間を形成した樹脂層である。まず、図１３（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極3はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図１３（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層１５を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。次に図１３（ｃ）に示すように、封止板の片面に振動電極近傍領域を除いてスクリーン印刷により樹脂を印刷し樹脂層１５を形成する。次に樹脂中の溶媒が揮発し、タック性がなくなるまで乾燥する。この樹脂は、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。次に、樹脂層を形成した圧電共振子と封止板を、加熱し半硬化状態にする。加熱条件は、樹脂の架橋密度により決定される。架橋密度は６０％以下が望ましい。次に、図１３（ｄ）に示すように、樹脂層を形成した封止板上に圧電共振子を樹脂層が形成された面を上にして載置しさらにその上から他方の封止板を載置して挟持し、１～１０kg/cm^{2}の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、１０kg/cm^{2}より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第１１の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂層の厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１１では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００２２】（実施の形態１２）次に本発明の圧電共振部品の製造方法に関する第１２の形態について、図１４を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１７は圧電共振子１１の振動空間を形成した樹脂フィルム層である。まず、図１４（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極１２と引き出し電極１３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図１４（ｂ）に示すように、アルミナや誘電体セラミックもしくは樹脂などの材料から構成されている封止板１４の表面に、圧電共振子の振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層１７を形成する。この樹脂フィルムは、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度＋３０℃の範囲の温度で１～５kg/cm^{2}の圧力でラミネートすることがが望ましい。次に、図１４（ｃ）に示すように、樹脂フィルム層を形成した封止板上に圧電共振子を載置しさらにその上から他方の封止板を載置して挟持し、１～１０kg/cm^{2}の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、１０kg/cm^{2}より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第１２の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂フィルムの厚みは、１０μmより薄いと密封性が低下し、１００μm以上の場合は外部電極との密着性が低下するため、１０μm以上１００μm以下が望ましい。尚、本実施の形態１２では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合に

おいても同様な効果がある。

【００２３】（実施の形態１３）次に本発明の圧電共振部品の製造方法に関する第１３の形態について、図１５を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１７は圧電共振子１１の振動空間を形成した樹脂フィルム層である。まず、図１５（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極１２と引き出し電極１３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図１５（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層１７を形成する。次に圧電共振子の残り主面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層１７を形成する。この樹脂フィルムは、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度＋３０℃の範囲の温度で１～５kg/cm²の圧力でラミネートすることがが望ましい。次に、図１５（ｃ）に示すように、樹脂フィルム層を形成した圧電共振子の両面上に封止板を載置して挟持し、１～１０kg/cm²の加圧下で、１５０℃１時間加熱し、樹脂フイルムを本硬化させ一体化する。本硬化時の加圧が、１０kg/cm²より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第１３の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂フィルムの厚みは、１０μｍより薄いと密封性が低下し、１００μｍ以上の場合は外部電極との密着性が低下するため、１０μｍ以上１００μｍ以下が望ましい。尚、本実施の形態１３では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００２４】（実施の形態１４）次に本発明の圧電共振部品の製造方法に関する第７の形態について、図１６を用いて説明する。同図において１１は圧電共振子、１２は振動電極、１３は引き出し電極、１４は封止板、１７は圧電共振子１１の振動空間を形成した樹脂フィルム層である。まず、図１６（ａ）に示すように、例えばＰＺＴ等の圧電セラミック材料からなる圧電共振子に、振動電極２と引き出し電極３はクロム及びニッケルをスパッタリング法などの乾式成膜法により形成する。次に、図１６（ｂ）に示すように、圧電共振子の一方の主面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層１７を形成する。次に図１６（ｃ）に示すように、封止板の片面に振動電極近傍領域を除いて未硬化もしくは半硬化の樹脂フィルムをラミネートし樹脂フィルム層１７を形成する。この樹脂フィルムは、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の熱硬化性樹脂を主成分とする樹脂を用いる。尚、熱硬化性樹脂の最低溶融粘度は、レオメーターを用い求めたものである。ラミネート条件は、樹脂の軟化温度により決定される。軟化温度と軟化温度＋３０℃の範囲の温度で１～５kg/cm²の圧力でラミネートすることがが望ましい。次に、図１６（ｄ）に示すように、樹脂フィルム層を形成した封止板上に圧電共振子を樹脂フィルム層が形成された面を上にして載置しさらにその上から他方の封止板を載置して挟持し、１～１０kg/cm²の加圧下で、１５０℃１時間加熱し、樹脂を本硬化させ一体化する。本硬化時の加圧が、１０kg/cm²より高い圧力の時は、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させたため、最低溶融粘度の下限値を高くした樹脂を用いることが必要となる。次にダイシング装置により端部を切断し引き出し電極の一部を露出させ露出した端部上にクロム及びニッケルをスパッタリング法などの乾式成膜法により形成し、さらにその上に、電解めっき法によりニッケル及び半田を析出させ、外部電極を形成する。上記第１４の実施形態にかかる圧電共振部品の製造方法では、上述した構成により、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。樹脂フィルムの厚みは、１０μｍより薄いと密封性が低下し、１００μｍ以上の場合は外部電極との密着性が低下するため、１０μｍ以上１００μｍ以下が望ましい。尚、本実施の形態１４では、１つの圧電共振子を２つの封止板で挟持した場合について述べたが、複数の圧電共振子を挟持する場合においても同様な効果がある。

【００２５】なお、以上述べた本発明の実施の形態の効果を確認するため、ガラス転移温度を色々異ならせて作成したものについて、密封性を実験したところ、表１の結果が得られた。

【００２６】

【表１】

ガラス転移温度（℃）	50	70	90	105	125	140
密封性	NG	NG	NG	G	G	G

【００２７】表１から明らかなように、ガラス転移温度１００℃以上の場合が密封性が高いことが分かる。

【００２８】また、最低溶融粘度を色々異ならせて作成したものについて、その浸みだし係数を測定したところ、表２のような結果が得られた。

【００２９】

【表２】

最低溶融粘土（Ｐａ・Ｓ）	5	10	20	30	50	100
浸みだし係数　注(1)	>10	>10	<3	<2	<2	<2
判定	NG	NG	G	G	G	G

注(1) 浸みだし係数＝浸みだし幅÷樹脂層厚み

【００３０】表２から明らかなように、最低溶融粘度が２０以上の場合、浸みだし係数が良い結果を示すことがわかる。なお、この浸みだし係数とは、浸みだし係数＝（浸みだし幅）／（樹脂厚さ）で表され、その浸みだし幅と、樹脂厚さは図１９に示すような条件で定義される量である。

【００３１】

【発明の効果】以上のように本発明によれば、ガラス転移温度が１００℃以上の樹脂もしくは樹脂フィルムにより封止板と圧電共振子を接着しているので、実使用環境内の温度変化（－４０℃から８５℃）においても、封止板４と圧電共振子１の接着性低下を防ぎ、十分な振動空間の密封性を得ることができる。

【００３２】また、加熱硬化時の最低溶融粘度が２０Ｐａ・ｓ以上の樹脂もしくは樹脂フィルムにより封止板と圧電共振子を接着しているので、本硬化させる工程で熱や圧力がかかることにより、樹脂層１５が硬化過程で流動し、圧電共振子の振動電極側に樹脂層がしみ出して振動を妨げて圧電共振子の特性を劣化させるという課題を解決し、高信頼性かつ安定した特性を得ることができる。

【図面の簡単な説明】

【図１】本発明の実施の形態１における圧電共振部品の切り欠き斜視図

【図２】（ａ）は同実施の形態１における圧電共振部品の斜視図、（ｂ）は図２（ａ）のＡ－Ａ面での部分断面図

【図３】本発明の実施の形態２における圧電共振部品の積層前の分解斜視図

【図４】本発明の実施の形態３における圧電共振部品の積層前の分解斜視図

【図５】本発明の実施の形態４における圧電共撮部品の積層前の分解斜視図

【図６】本発明の実施の形態５における圧電共振部品の積層前の分解斜視図

【図７】本発明の実施の形態６における圧電共振部品の積層前の分解斜視図

【図８】本発明の実施の形態７における圧電共撮部品の積層前の分解斜視図

【図９】本発明の実施の形態８における圧電共振部品の切り欠き斜視図

【図１０】（ａ）は同実施の形態８における圧電共振部品の斜視図、（ｂ）は図１０（ａ）のＡ－Ａ面での部分断面図

【図１１】本発明の実施の形態９における圧電共振部品の積層前の分解斜視図

【図１２】本発明の実施の形態１０における圧電共振部品の積層前の分解斜視図

【図１３】本発明の実施の形態１１における圧電共撮部品の積層前の分解斜視図

【図１４】本発明の実施の形態１２における圧電共振部品の積層前の分解斜視図

【図１５】本発明の実施の形態１３における圧電共振部品の積層前の分解斜視図

【図１６】本発明の実施の形態１４における圧電共撮部品の積層前の分解斜視図

【図１７】従来の圧電共振部品の積層前の分解斜視図

【図１８】（ａ）は従来の圧電共振部品の斜視図、（ｂ）は図１８（ａ）のＡ－Ａ面での部分断面図

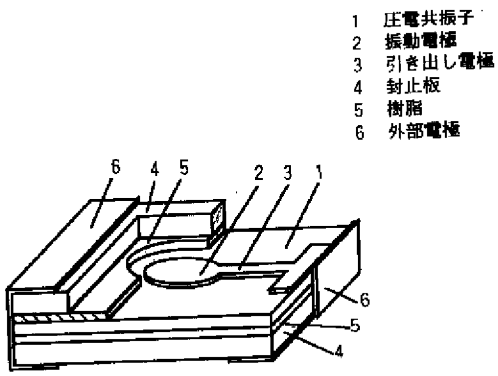
【図１９】本発明の実施の形態における最低溶融粘度の効果を確かめる場合に用いられる浸みだし係数を示す図面

（符号の説明）

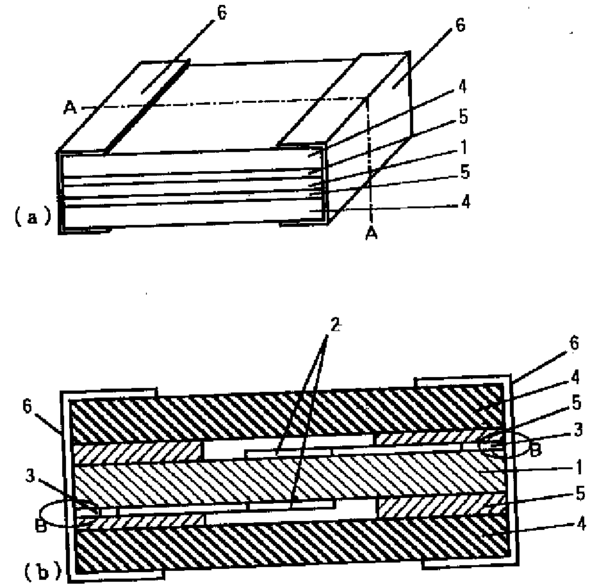
１　圧電共振子
２　振動電極
３　引き出し電極
４　封止板
５　樹脂層

６　　外部電極
１１　圧電共振子
１２　振動電極
１３　引き出し電極
１４　封止板
１５　樹脂層
１６　外部電極
１７　樹脂フィルム層
２１　圧電共振子
２２　振動電極
２３　引き出し電極
２４　封止板
２５　樹脂
２６　外部電極

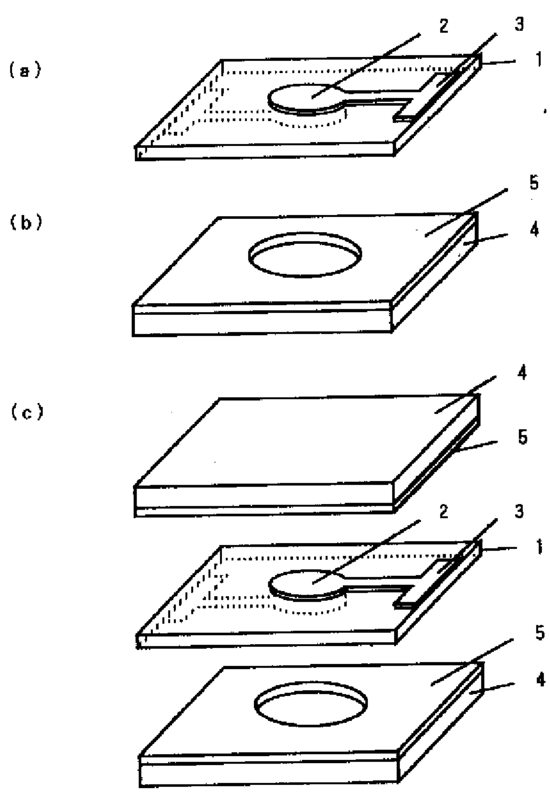
【図１】



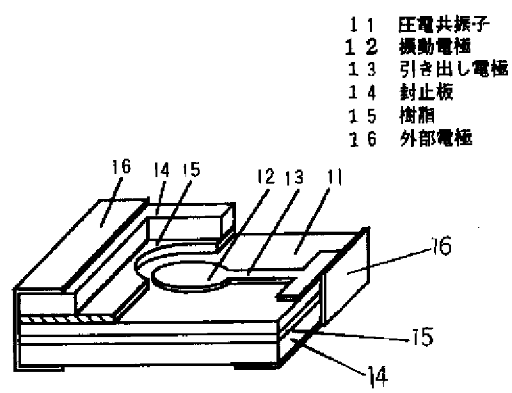
【図２】



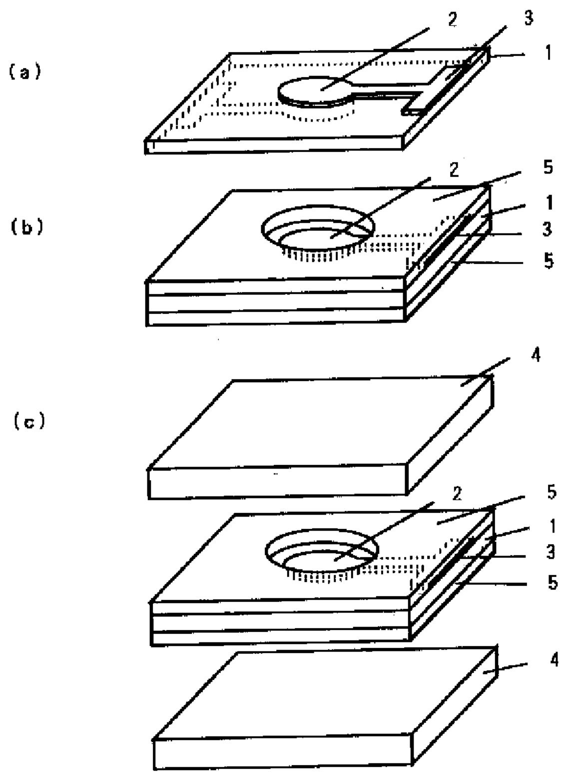
【図３】



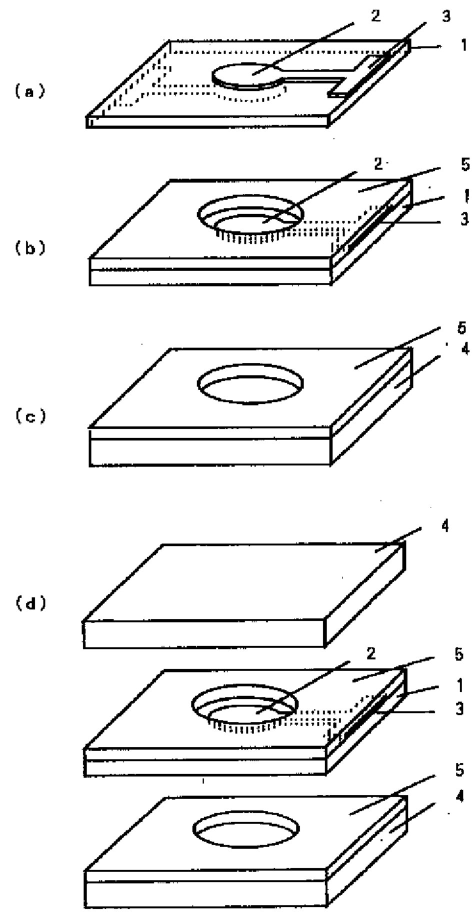
【図９】



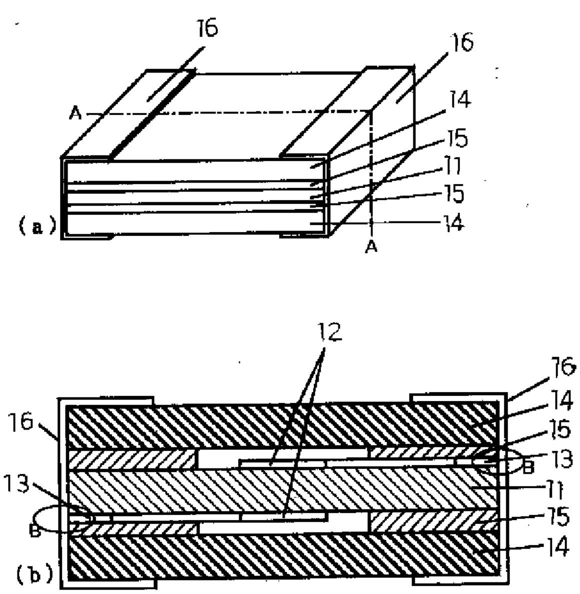
【図4】


(a)
(b)
(c)
1
2
3
4
5

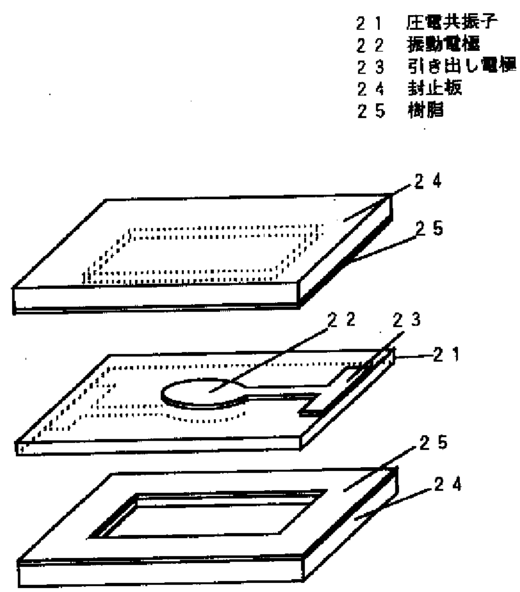
【図5】


(a)
(b)
(c)
(d)
1
2
3
4
5

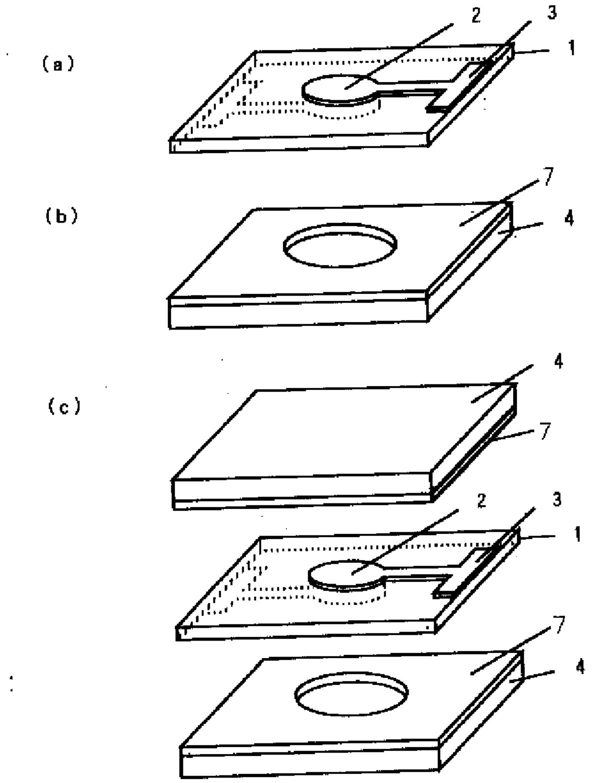
【図10】


(a)
(b)
A
B
11
12
13
14
15
16

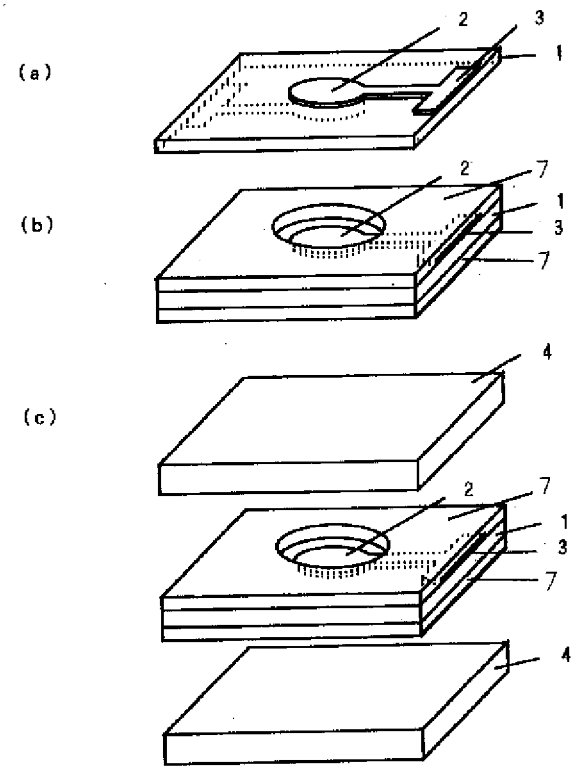
【図17】


２１　圧電共振子
２２　振動電極
２３　引き出し電極
２４　封止板
２５　樹脂

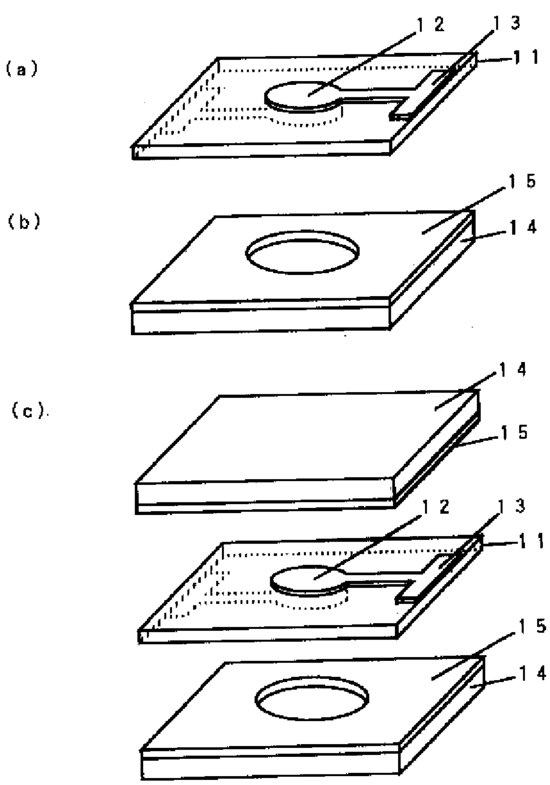
【図6】


(a)
2
3
1
(b)
7
4
(c)
4
7
2
3
1
7
4

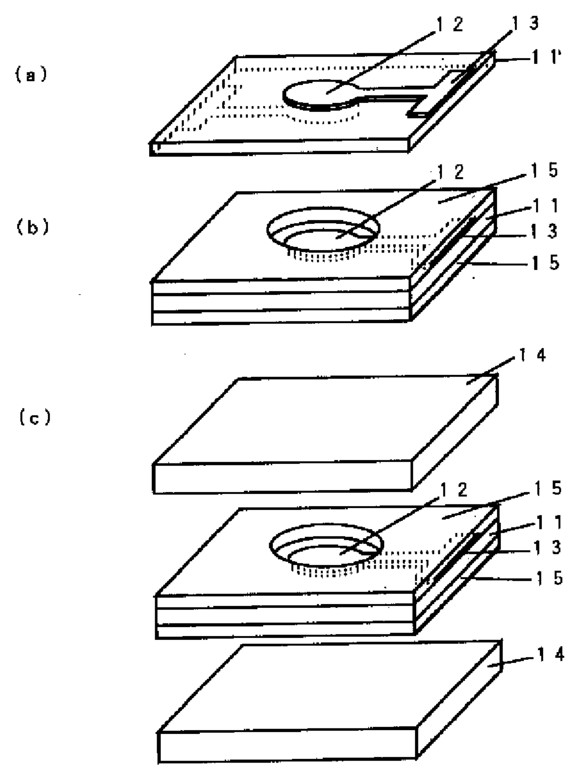
【図7】


(a)
2
3
1
(b)
2
7
1
3
7
(c)
4
2
7
1
3
7
4

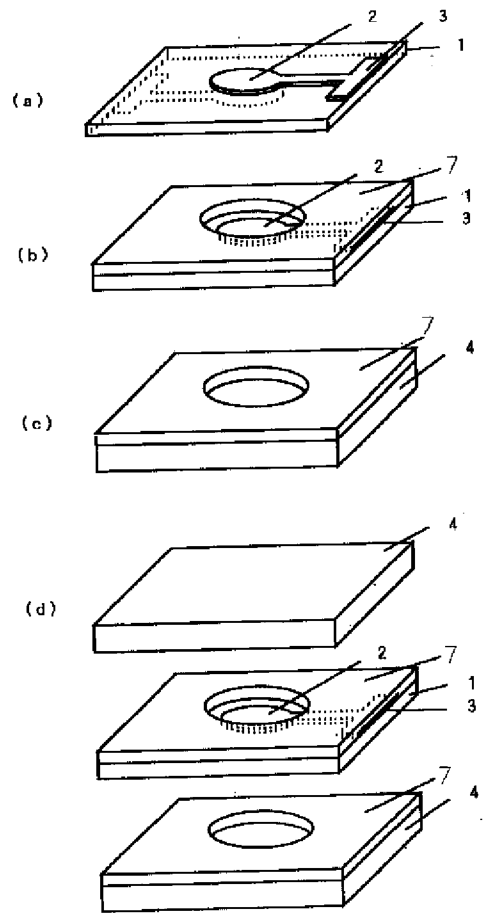
【図11】


(a)
12
13
11
(b)
15
14
(c)
14
15
12
13
11
15
14

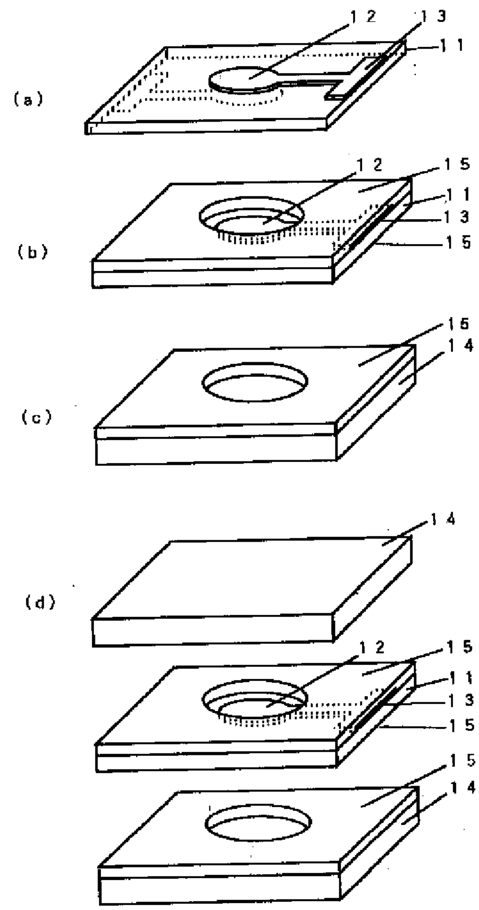
【図12】


(a)
12
13
11'
(b)
12
15
11
13
15
(c)
14
12
15
11
13
15
14

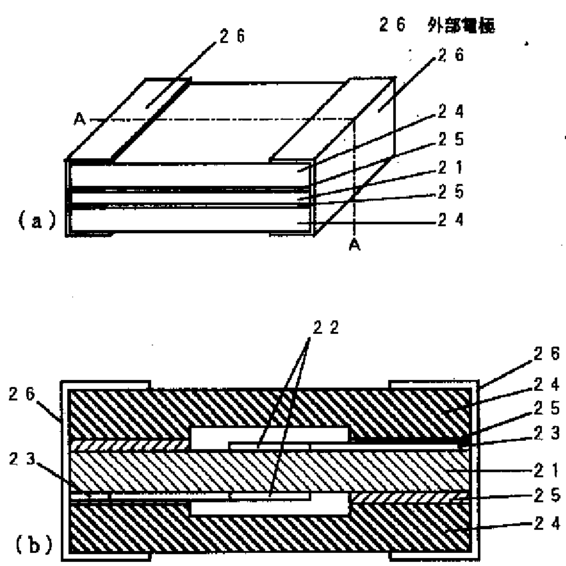
【図8】



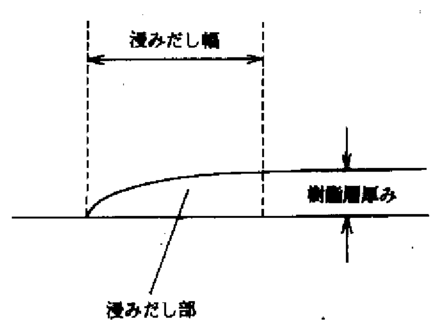
【図13】



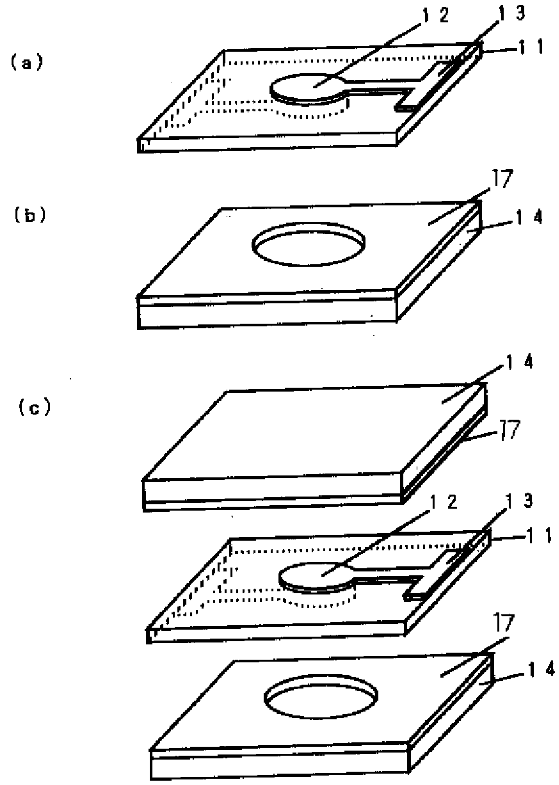
【図18】



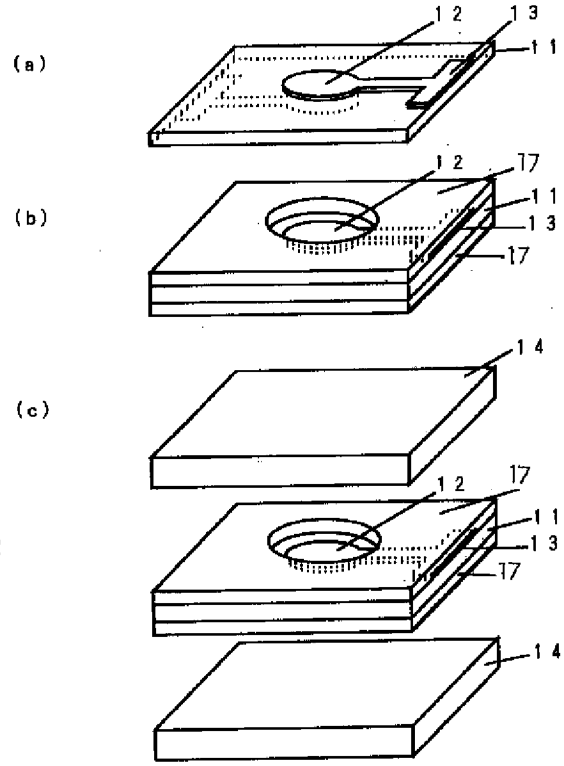
【図19】



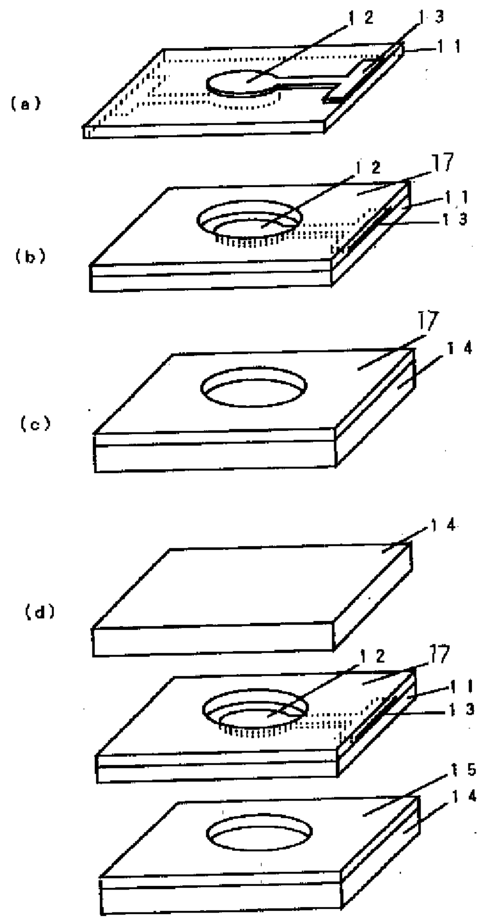
【図14】


(a)
12
13
11
(b)
17
14
(c)
14
17
12
13
11
17
14

【図15】


(a)
12
13
11
(b)
12
17
11
13
17
(c)
14
12
17
11
13
17
14

【図１６】



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